

## Positive-Voltage Regulator

### ◆ Description

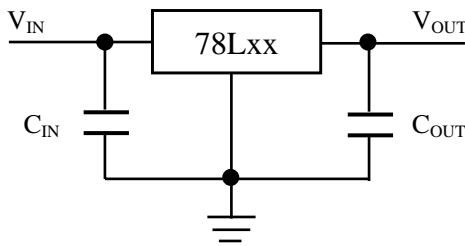
The 78Lxx series are fixed-voltage monolithic integrated circuit voltage regulators are designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. In addition, they can be used with power-pass elements to make high-current voltage regulators. Each of these regulators can deliver up to 100mA of output current.

The internal limiting and thermal shunt-down features of these regulators make them essentially immune to overload.

### ◆ Features

- Three Terminal Regulators.
- Output Current up to:100mA
- No External Components.
- Internal Thermal Overload Protection.
- Internal Short-Circuit Limiting.

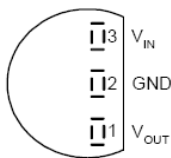
### ◆ Typical Application



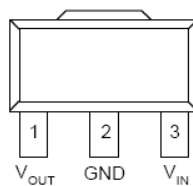
### ◆ Applications

- Linear Regulator
- Graphic Card
- Adapter
- Charger

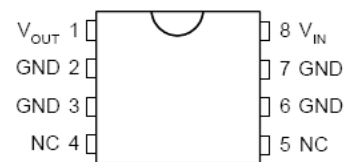
### ◆ Pin Description



**TO-92 (Top View)**



**SOT-89 (Front View)**



**SOP-8 (Top View)**

**◆ Ordering Information**

Part Number	Temperature Range	Package	Pin Assignment			Packing
			Input	GND	Output	
78L05EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L05DI		SOT-89	3	2	1	Tape & Reel
78L05KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L06EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L06DI		SOT-89	3	2	1	Tape & Reel
78L06KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L08EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L08DI		SOT-89	3	2	1	Tape & Reel
78L08KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L09EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L09DI		SOT-89	3	2	1	Tape & Reel
78L09KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L10EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L10DI		SOT-89	3	2	1	Tape & Reel
78L10KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L12EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L12DI		SOT-89	3	2	1	Tape & Reel
78L12KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L15EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L15DI		SOT-89	3	2	1	Tape & Reel
78L15KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L18EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L18DI		SOT-89	3	2	1	Tape & Reel
78L18KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel
78L24EI	-40 °C ~ +125 °C	TO-92	3	2	1	Plastic & Box
78L24DI		SOT-89	3	2	1	Tape & Reel
78L24KI		SOP-8	8	2, 3, 6, 7	1	Tape & Reel

**◆ Absolute Maximum Ratings**

Symbol	Parameter	Value			Unit
		78L05~78L10	78L12~78L18	78L24	
$V_{IN}$	Input voltage	30	35	40	V
$I_{OUT}$	Output current	0.1			A
$T_A$	Operating ambient temperature	-40 ~ +125			°C
$T_J$	Operating junction temperature	150			°C
$T_{STG}$	Storage temperature	-65 ~ +150			°C
$T_{LEAD}$	Lead temperature 1.6mm from case for 10 seconds	260			°C

**◆ Thermal Characteristics**

Symbol	Parameter	Package	Typical Value	Unit
$\theta_{JA}$	Thermal Resistance From Junction to Ambient in Free Air. (Measured with the component mounted on a high effective thermal conductivity test board in free air.)	TO-92	180	°C/W
		SOT-89	180	
		SOP-8	160	

**◆ Recommended Operating Conditions**

Symbol	Parameter	Min.	Max.	Unit	
$V_{IN}$	Input voltage	78L05	7	20	V
		78L06	8	20	
		78L08	10.5	23	
		78L09	11.5	24	
		78L10	12.5	25	
		78L12	14.5	27	
		78L15	17.5	30	
		78L18	20.5	33	
		78L24	26.5	39	
$I_{OUT}$	Output current	-	0.1	A	
$T_J$	Operating virtual junction temperature	0	125	°C	

**◆ 78L05 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=10\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted.)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit
$V_{OUT}^{**}$	Output voltage			4.8	5.0	5.2	V
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=7\text{V to }20\text{V}$	0 to $125^{\circ}\text{C}$	4.75	5.00	5.25	
		$I_O=1\text{mA to }70\text{mA}$		5.25	5.00	5.25	
$\text{Reg}_{line}$	Line regulation	$V_{IN}=7\text{V to }20\text{V}$		-	32	150	mV
		$V_{IN}=8\text{V to }20\text{V}$		-	26	100	
$\text{Reg}_{load}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	8	30	mV
		$I_O=1\text{mA to }100\text{mA}$		-	15	60	
PSRR	Ripple rejection	$V_{IN}=8\text{V to }18\text{V}$ , $f=120\text{Hz}$		41	49	-	dB
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	42	-	$\mu\text{V}$
$V_{DROPOUT}$	Dropout voltage			-	1.7	-	V
$I_Q$	Bias current			-	3.8	6.0	mA
		$125^{\circ}\text{C}$		-	-	5.5	
$\Delta I_Q$	Bias current change	$V_{IN}=8\text{V to }20\text{V}$		-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$		-	-	0.1	

**◆ 78L06 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=11\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted.)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit
$V_{OUT}^{**}$	Output voltage			5.75	6.00	6.25	V
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=8\text{V to }20\text{V}$	0 to $125^{\circ}\text{C}$	5.7	6.0	6.3	
		$I_O=1\text{mA to }70\text{mA}$		5.7	6.0	6.3	
$\text{Reg}_{line}$	Line regulation	$V_{IN}=8\text{V to }20\text{V}$		-	35	175	mV
		$V_{IN}=9\text{V to }20\text{V}$		-	29	125	
$\text{Reg}_{load}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	9	40	mV
		$I_O=1\text{mA to }100\text{mA}$		-	16	80	
PSRR	Ripple rejection	$V_{IN}=9\text{V to }19\text{V}$ , $f=120\text{Hz}$		40	48	-	dB
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	46	-	$\mu\text{V}$
$V_{DROPOUT}$	Dropout voltage			-	1.7	-	V
$I_Q$	Bias current			-	3.9	6.0	mA
		$125^{\circ}\text{C}$		-	-	5.5	
$\Delta I_Q$	Bias current change	$V_{IN}=9\text{V to }20\text{V}$		-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$		-	-	0.1	

**◆ 78L08 Electrical Characteristics** ( $T_A=25^\circ\text{C}$ ,  $V_{IN}=14\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted.)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit
$V_{OUT}^{**}$	Output voltage			7.7	8.0	8.3	V
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=10.5\text{V to }23\text{V}$	0 to $125^\circ\text{C}$	7.6	8.0	8.4	
		$I_O=1\text{mA to }70\text{mA}$		7.6	8.0	8.4	
$\text{Reg}_{line}$	Line regulation	$V_{IN}=10.5\text{V to }23\text{V}$		-	42	175	mV
		$V_{IN}=11\text{V to }23\text{V}$		-	36	125	
$\text{Reg}_{load}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	10	40	mV
		$I_O=1\text{mA to }100\text{mA}$		-	18	80	
PSRR	Ripple rejection	$V_{IN}=13\text{V to }23\text{V}$ , $f=120\text{Hz}$		37	46	-	dB
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	54	-	$\mu\text{V}$
$V_{DROPOUT}$	Dropout voltage			-	1.7	-	V
$I_Q$	Bias current			-	4	6	mA
		$125^\circ\text{C}$		-	-	5.5	
$\Delta I_Q$	Bias current change	$V_{IN}=11\text{V to }23\text{V}$	0 to $125^\circ\text{C}$	-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$		-	-	0.1	

**◆ 78L09 Electrical Characteristics** ( $T_A=25^\circ\text{C}$ ,  $V_{IN}=16\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted.)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit
$V_{OUT}^{**}$	Output voltage			8.6	9.0	9.4	V
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=12\text{V to }24\text{V}$	0 to $125^\circ\text{C}$	8.55	9.0	9.45	
		$I_O=1\text{mA to }70\text{mA}$		8.55	9.0	9.45	
$\text{Reg}_{line}$	Line regulation	$V_{IN}=12\text{V to }24\text{V}$		-	45	175	mV
		$V_{IN}=13\text{V to }24\text{V}$		-	40	125	
$\text{Reg}_{load}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	11	40	mV
		$I_O=1\text{mA to }100\text{mA}$		-	19	90	
PSRR	Ripple rejection	$V_{IN}=15\text{V to }25\text{V}$ , $f=120\text{Hz}$		38	45	-	dB
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	58	-	$\mu\text{V}$
$V_{DROPOUT}$	Dropout voltage			-	1.7	-	V
$I_Q$	Bias current			-	4.1	6.0	mA
		$125^\circ\text{C}$		-	-	5.5	
$\Delta I_Q$	Bias current change	$V_{IN}=13\text{V to }24\text{V}$	0 to $125^\circ\text{C}$	-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$		-	-	0.1	

**◆ 78L10 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=17\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted .)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit	
$V_{OUT}^{**}$	Output voltage			9.6	10	10.4	V	
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=13\text{V to }25\text{V}$	0 to $125^{\circ}\text{C}$	9.5	10	10.5		
		$I_O=1\text{mA to }70\text{mA}$		9.5	10	10.5		
$\text{Reg}_{\text{line}}$	Line regulation	$V_{IN}=13\text{V to }25\text{V}$		-	51	175	mV	
		$V_{IN}=14\text{V to }25\text{V}$		-	42	125		
$\text{Reg}_{\text{load}}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	11	40	mV	
		$I_O=1\text{mA to }100\text{mA}$		-	20	90		
PSRR	Ripple rejection	$V_{IN}=15\text{V to }25\text{V}$ , $f=120\text{Hz}$		37	44	-	dB	
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	62	-	$\mu\text{V}$	
$V_{\text{DROPOUT}}$	Dropout voltage			-	1.7	-	V	
$I_Q$	Bias current			-	4.2	6.0	mA	
		$125^{\circ}\text{C}$		-	-	5.5		
$\Delta I_Q$	Bias current change	$V_{IN}=14\text{V to }25\text{V}$		0 to $125^{\circ}\text{C}$	-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$			-	-	0.1	

**◆ 78L12 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=19\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted .)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit	
$V_{OUT}^{**}$	Output voltage			11.5	12.0	12.5	V	
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=14\text{V to }27\text{V}$	0 to $125^{\circ}\text{C}$	11.4	12.0	12.6		
		$I_O=1\text{mA to }70\text{mA}$		11.4	12.0	12.6		
$\text{Reg}_{\text{line}}$	Line regulation	$V_{IN}=14\text{V to }27\text{V}$		-	55	250	mV	
		$V_{IN}=16\text{V to }27\text{V}$		-	49	200		
$\text{Reg}_{\text{load}}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	13	50	mV	
		$I_O=1\text{mA to }100\text{mA}$		-	22	100		
PSRR	Ripple rejection	$V_{IN}=15\text{V to }25\text{V}$ , $f=120\text{Hz}$		37	42	-	dB	
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	70	-	$\mu\text{V}$	
$V_{\text{DROPOUT}}$	Dropout voltage			-	1.7	-	V	
$I_Q$	Bias current			-	4.3	6.5	mA	
		$125^{\circ}\text{C}$		-	-	6.0		
$\Delta I_Q$	Bias current change	$V_{IN}=16\text{V to }27\text{V}$		0 to $125^{\circ}\text{C}$	-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$			-	-	0.1	

**◆ 78L15 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=23\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted .)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit
$V_{OUT}^{**}$	Output voltage			14.4	15.0	15.6	V
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=17.5\text{V to }30\text{V}$	0 to $125^{\circ}\text{C}$	14.25	15.0	15.75	
		$I_O=1\text{mA to }70\text{mA}$		14.25	15	15.75	
$\text{Reg}_{line}$	Line regulation	$V_{IN}=17.5\text{V to }30\text{V}$		-	65	300	mV
		$V_{IN}=19\text{V to }30\text{V}$		-	58	250	
$\text{Reg}_{load}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	15	75	mV
		$I_O=1\text{mA to }100\text{mA}$		-	25	150	
PSRR	Ripple rejection	$V_{IN}=18.5\text{V to }28.5\text{V}$ , $f=120\text{Hz}$		34	39	-	dB
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	82	-	$\mu\text{V}$
$V_{DROPOUT}$	Dropout voltage			-	1.7	-	V
$I_Q$	Bias current			-	4.6	6.5	mA
		$125^{\circ}\text{C}$		-	-	6.0	
$\Delta I_Q$	Bias current change	$V_{IN}=19\text{V to }30\text{V}$		-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$		-	-	0.1	

**◆ 78L18 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=26\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted .)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit
$V_{OUT}^{**}$	Output voltage			17.3	18.0	18.7	V
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=20.5\text{V to }33\text{V}$	0 to $125^{\circ}\text{C}$	17.1	18.0	18.9	
		$I_O=1\text{mA to }70\text{mA}$		17.1	18	18.9	
$\text{Reg}_{line}$	Line regulation	$V_{IN}=20.5\text{V to }33\text{V}$		-	70	360	mV
		$V_{IN}=22\text{V to }33\text{V}$		-	64	300	
$\text{Reg}_{load}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	19	90	mV
		$I_O=1\text{mA to }100\text{mA}$		-	27	180	
PSRR	Ripple rejection	$V_{IN}=21.5\text{V to }31.5\text{V}$ , $f=120\text{Hz}$		32	36	-	dB
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	89	-	$\mu\text{V}$
$V_{DROPOUT}$	Dropout voltage			-	1.7	-	V
$I_Q$	Bias current			-	4.7	6.5	mA
		$125^{\circ}\text{C}$		-	-	6.0	
$\Delta I_Q$	Bias current change	$V_{IN}=22\text{V to }33\text{V}$		-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$		-	-	0.1	

**◆ 78L24 Electrical Characteristics** ( $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=32\text{V}$ ,  $I_{OUT}=40\text{mA}$ , unless otherwise noted .)

Symbol	Parameter	Test Conditions*		Min.	Typ.	Max.	Unit
$V_{OUT}^{**}$	Output voltage			23	24	25	V
		$I_O=1\text{mA to }40\text{mA}$ $V_{IN}=26.5\text{V to }39\text{V}$	0 to $125^{\circ}\text{C}$	22.8	24.0	25.2	
		$I_O=1\text{mA to }70\text{mA}$		22.8	24.0	25.2	
$\text{Reg}_{line}$	Line regulation	$V_{IN}=26.5\text{V to }39\text{V}$		-	95	480	mV
		$V_{IN}=29\text{V to }39\text{V}$		-	78	400	
$\text{Reg}_{load}$	Load regulation	$I_O=1\text{mA to }40\text{mA}$		-	28	120	mV
		$I_O=1\text{mA to }100\text{mA}$		-	41	240	
PSRR	Ripple rejection	$V_{IN}=27.5\text{V to }37.5\text{V}$ , $f=120\text{Hz}$		30	33	-	dB
$V_n$	Output noise voltage	$F=10\text{Hz}\sim 100\text{Hz}$		-	97	-	$\mu\text{V}$
$V_{DROPOUT}$	Dropout voltage			-	1.7	-	V
$I_Q$	Bias current			-	4.8	6.5	mA
		$125^{\circ}\text{C}$		-	-	6.0	
$\Delta I_Q$	Bias current change	$V_{IN}=28\text{V to }39\text{V}$		-	-	1.5	mA
		$I_O=1\text{mA to }40\text{mA}$		-	-	0.1	

**Note:**

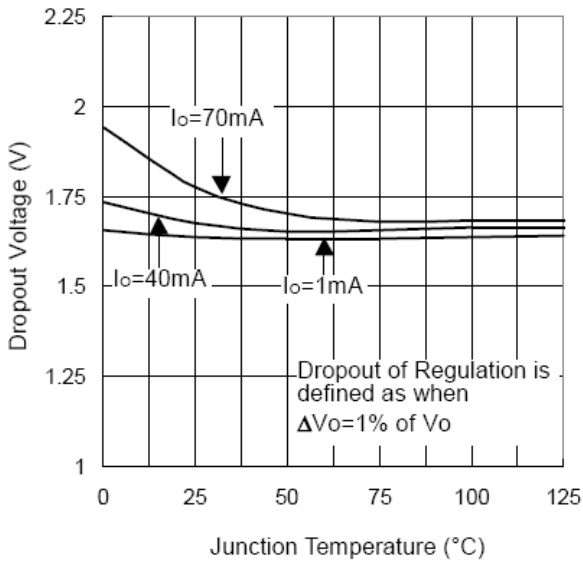
\* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33 $\mu\text{F}$  capacitor across the input and a 0.1 $\mu\text{F}$  capacitor across the output.

\*\* The specification applies only for DC power dissipation permitted by absolute maximum rating.

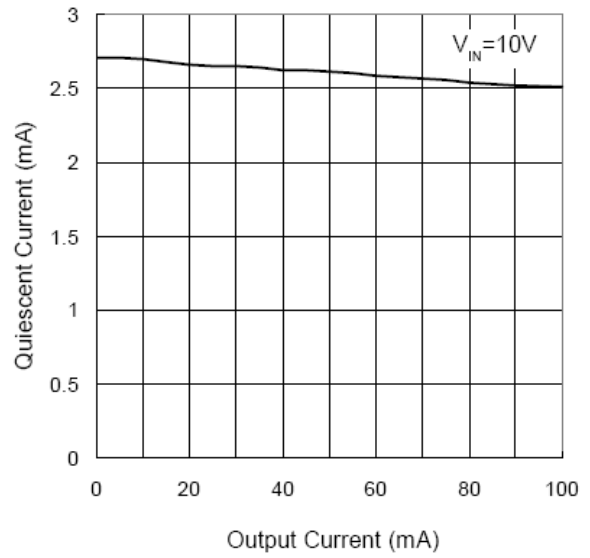


◆ Typical Application Circuits (78L05)

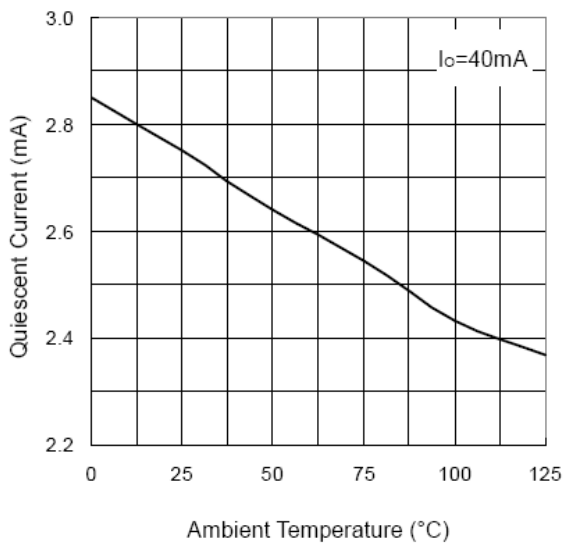
**Dropout Voltage vs. Junction Temperature**



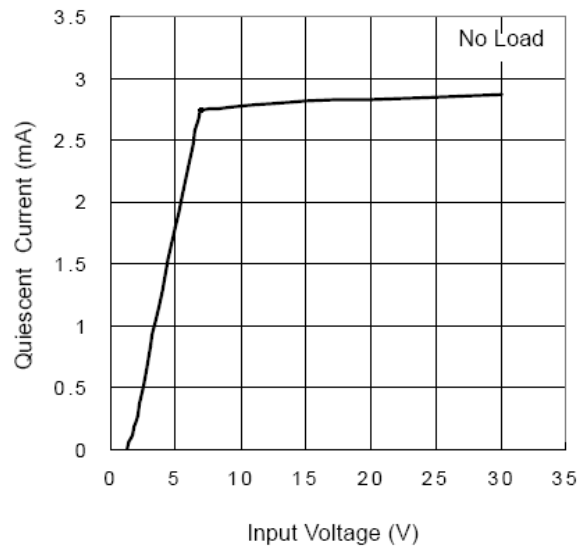
**Quiescent Current vs. Output Current**

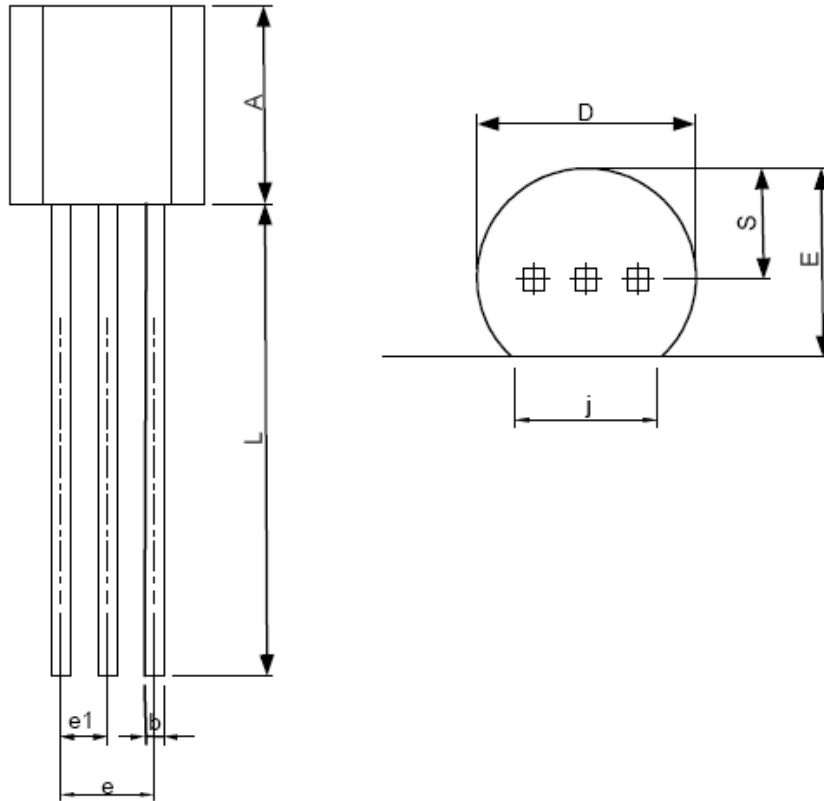


**Quiescent Current vs. Ambient Temperature**

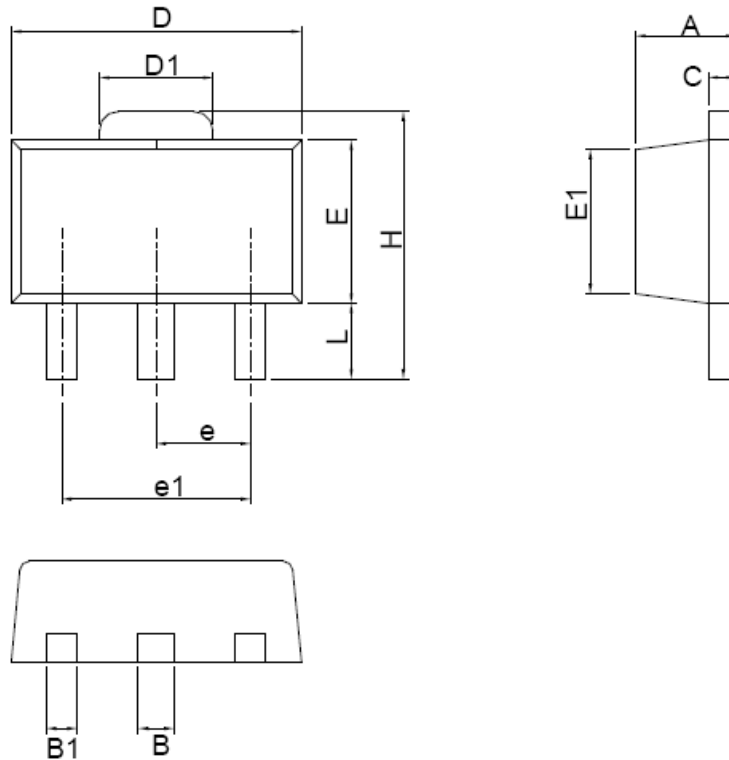


**Quiescent Current vs. Input Voltage**

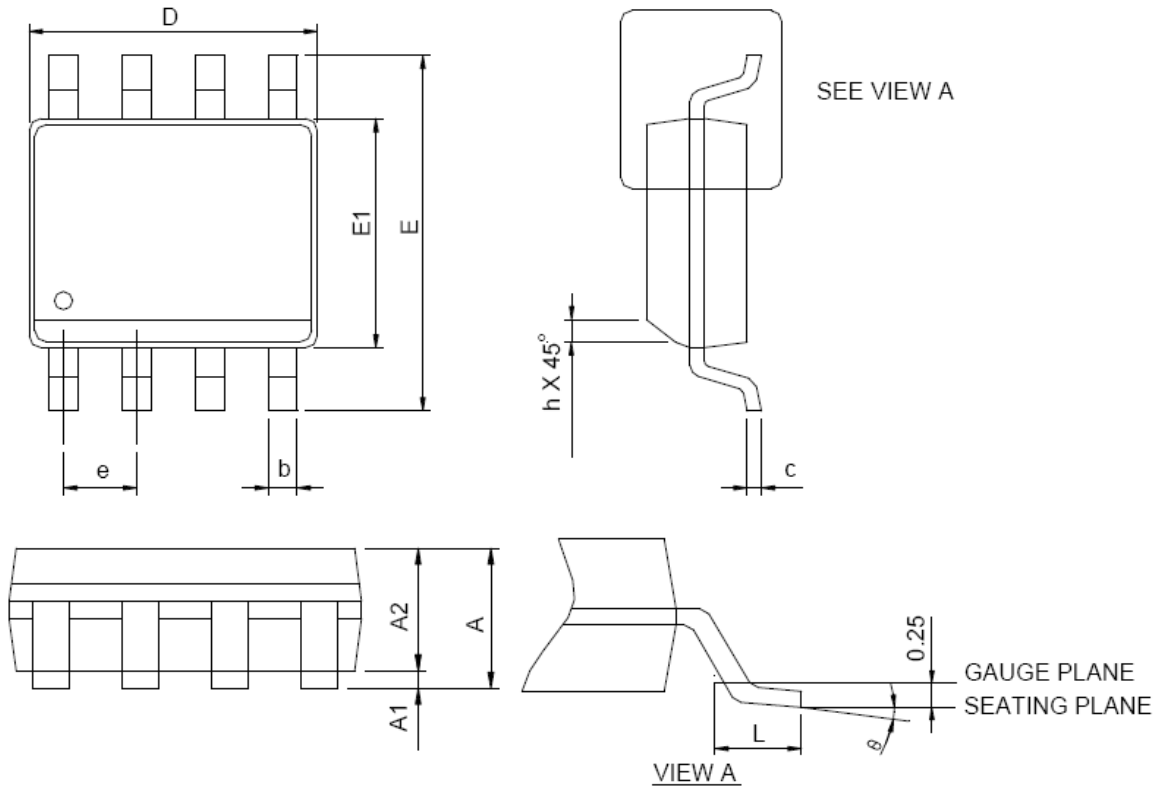


**◆ Package Information**
**TO-92**


SYMBOL	TO-92			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.32	5.33	0.170	0.210
b	0.41	0.53	0.016	0.021
D	4.45	5.20	0.175	0.205
E	3.18	4.19	0.125	0.165
e	2.42	2.66	0.095	0.105
e1	1.15	1.39	0.045	0.055
j	3.43	4.00	0.135	0.157
L	12.70	15.00	0.500	0.591
S	2.03	2.66	0.080	0.105

**◆ Package Information**
**SOT-89**


SYMBOL	SOT-89			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	1.40	1.60	0.055	0.063
B	0.44	0.56	0.017	0.022
B1	0.36	0.48	0.014	0.019
C	0.35	0.44	0.014	0.017
D	4.40	4.60	0.173	0.181
D1	1.62	1.83	0.064	0.072
E	2.29	2.60	0.090	0.102
E1	2.13	2.29	0.084	0.090
e	1.50 BSC		0.059 BSC	
e1	3.00 BSC		0.118 BSC	
H	3.94	4.25	0.155	0.167
L	0.89	1.20	0.035	0.047

**◆ Package Information**
**SOP-8**


SYMBOL	SOP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.75		0.069
A1	0.10	0.25	0.004	0.010
A2	1.25		0.049	
b	0.31	0.51	0.012	0.020
c	0.17	0.25	0.007	0.010
D	4.80	5.00	0.189	0.197
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
h	0.25	0.50	0.010	0.020
L	0.40	1.27	0.016	0.050
$\theta$	0°	8°	0°	8°