Positive voltage regulators

1. Description

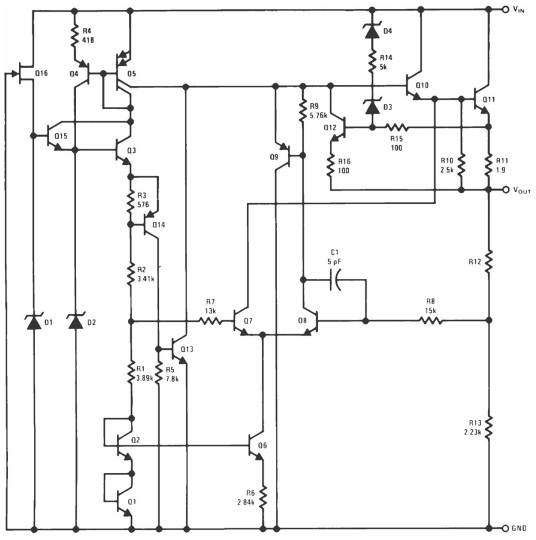
The LM78Lxx series of three-terminal positive regulators employ internal current limiting and thermal shutdown, making them essentially indestructible. If adequate heat-sink is provided, they can deliver up to 100 mA output current. They are intended as fixed voltage regulators in a wide range of applications including local or 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. The LM78Lxx series used as Zener diode/resistor combination replacement, offers an effective output impedance improvement of typically two orders of magnitude, along with lower quiescent current and lower noise.

2. Features

- Output current up to 100 mA
- Output voltages of 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V, 33V.
- Thermal overload protection
- Short circuit protection
- No external components are required
- Availableineither±5%

SOP-8	SOT-89	TO-92	SOT23-3
			

3. Functional Block Diagram



4. Ordering Information

Type Number	Package Type	Packing
LM78L05D	SOP-8	Tape & Reel
LM78L06D		
LM78L08D		
LM78L09D		
LM78L10D		
LM78L12D		
LM78L15D		
LM78L18D		
LM78L20D		
LM78L24D		
LM78L33D		
LM78L05PK	SOT-89	Tape & Reel
LM78L06PK		
LM78L08PK		
LM78L09PK		
LM78L10PK		
LM78L12PK		
LM78L15PK		
LM78L18PK		
LM78L20PK		
LM78L24PK		
LM78L33PK		
LM78L05LP	TO-92	Bag
LM78L06LP		
LM78L08LP		
LM78L09LP		
LM78L10LP		
LM78L12LP		
LM78L15LP		
LM78L18LP		
LM78L20LP		
LM78L24LP		
LM78L33LP		
LM78L05DBV	SOT23-3	Tape & Reel
LM78L06DBV		
LM78L08DBV		
LM78L09DBV		

LM78L10DBV		
LM78L12DBV		
LM78L15DBV		
LM78L18DBV		
LM78L20DBV		
LM78L24DBV		
LM78L33DBV		

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.

5. ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter[2]		Value	Unit
V_I	DC Input Voltage	V_O = 5 to 10 V	30	V
		V_O = 12 to 15 V	35	
		V_O = 18 to 33 V	40	
I_O	Output Current		100	mA
P_{tot}	Power Dissipation		Internally Limited (*)	
T_{stg}	Storage Temperature Range		-40 to 150	°C
T_{op}	Operating Junction Temperature Range		0 to 70	°C

6. ELECTRICAL CHARACTERISTICS

ELECTRICAL CHARACTERISTICS OF LM78L05

refer to the test circuits, V_I = 10V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	4.8	5	5.2	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 7 to 20 V	4.75		5.25	V
		I_O = 1 to 70 mA, V_I = 10 V	4.75		5.25	
ΔV_O	Line Regulation	V_I = 8.5 to 20 V, T_J = 25°C			150	mV
		V_I = 9 to 20 V, T_J = 25°C			100	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O =1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent Current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 8 to 20 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		40		V
SVR	Supply Voltage Rejection	V_I = 8 to 18 V, f = 120Hz I_O = 40 mA, T_J = 25°C	41	49		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L06

refer to the test circuits, V_I = 10V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	5.76	6	6.24	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 8.5 to 20 V	5.7		6.3	V
		I_O = 1 to 70 mA, V_I = 12 V	5.7		6.3	
ΔV_O	Line Regulation	V_I = 8.5 to 20 V, T_J = 25°C			150	mV
		V_I = 9 to 20 V, T_J = 25°C			100	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O =1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent Current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 9 to 20 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		50		V
SVR	Supply Voltage Rejection	V_I = 9 to 20 V, f = 120Hz I_O = 40 mA, T_J = 25°C	39	46		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L08

refer to the test circuits, V_I = 14V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	7.68	8	8.32	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 10.5 to 23 V	7.6		8.4	V
		I_O = 1 to 70 mA, V_I = 14 V	7.6		8.4	
ΔV_O	Line Regulation	V_I = 8.5 to 20 V, T_J = 25°C			175	mV
		V_I = 9 to 20 V, T_J = 25°C			125	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O =1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent Current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 11 to 23 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		60		V
SVR	Supply Voltage Rejection	V_I = 12 to 23V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	45		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L09

refer to the test circuits, V_I = 15V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	8.64	9	9.36	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 11.5 to 23 V	8.55		9.45	V
		I_O = 1 to 70 mA, V_I = 15 V	8.55		9.45	
ΔV_O	Line Regulation	V_I = 11.5 to 23 V, T_J = 25°C			225	mV
		V_I = 12 to 23 V, T_J = 25°C			150	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O =1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent Current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 12 to 23 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		70		V
SVR	Supply Voltage Rejection	V_I = 12 to 23V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	44		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L10

refer to the test circuits, V_I = 16V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	9.6	10	10.4	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 12.5 to 23 V	9.5		10.5	V
		I_O = 1 to 70 mA, V_I = 16 V	9.5		10.5	
ΔV_O	Line Regulation	V_I = 12.5 to 23 V, T_J = 25°C			230	mV
		V_I = 13 to 23 V, T_J = 25°C			170	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			80	mV
		I_O =1 to 40 mA, T_J = 25°C			40	
I_d	Quiescent Current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 13 to 23 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		60		V
SVR	Supply Voltage Rejection	V_I = 13 to 23V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	45		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L12

refer to the test circuits, V_I = 19V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	11.5	12	12.5	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 14.5 to 27 V	11.4		12.6	V
		I_O = 1 to 70 mA, V_I = 19 V	11.4		12.6	
ΔV_O	Line Regulation	V_I = 14.5 to 27 V, T_J = 25°C			250	mV
		V_I = 16 to 27 V, T_J = 25°C			200	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			100	mV
		I_O =1 to 40 mA, T_J = 25°C			50	
I_d	Quiescent Current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 16 to 27 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		80		V
SVR	Supply Voltage Rejection	V_I = 15 to 25V, f = 120Hz I_O = 40 mA, T_J = 25°C	37	42		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L15

refer to the test circuits, V_I = 23V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	14.4	15	15.6	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 17.5 to 30 V	14.25		15.75	V
		I_O = 1 to 70 mA, V_I = 23 V	14.25		15.75	
ΔV_O	Line Regulation	V_I = 17.5 to 30 V, T_J = 25°C			300	mV
		V_I = 20 to 30 V, T_J = 25°C			250	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			150	mV
		I_O =1 to 40 mA, T_J = 25°C			75	
I_d	Quiescent Current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 20 to 30 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		90		V
SVR	Supply Voltage Rejection	V_I = 18.5 to 28.5 V, f = 120Hz I_O = 40 mA, T_J = 25°C	34	39		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L18

refer to the test circuits, V_I = 27V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	17.3	18	18.7	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 22 to 33 V	17.1		18.9	V
		I_O = 1 to 70 mA, V_I = 27 V	17.1		18.9	
ΔV_O	Line Regulation	V_I = 21 to 33 V, T_J = 25°C			320	mV
		V_I = 22 to 33 V, T_J = 25°C			270	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			170	mV
		I_O =1 to 40 mA, T_J = 25°C			85	
I_d	Quiescent Current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 23 to 30 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		120		V
SVR	Supply Voltage Rejection	V_I = 23 to 33 V, f = 120Hz I_O = 40 mA, T_J = 25°C	33	38		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L20

refer to the test circuits, V_I = 29V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	19.2	20	20.8	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 24 to 33 V	19		21	V
		I_O = 1 to 70 mA, V_I = 29 V	19		21	
ΔV_O	Line Regulation	V_I = 22.5 to 34 V, T_J = 25°C			330	mV
		V_I = 24 to 34 V, T_J = 25°C			280	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			180	mV
		I_O =1 to 40 mA, T_J = 25°C			90	
I_d	Quiescent Current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 25 to 33 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		120		V
SVR	Supply Voltage Rejection	V_I = 25 to 35 V, f = 120Hz I_O = 40 mA, T_J = 25°C	32	38		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L24

refer to the test circuits, V_I = 33V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	23	24	25	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 27 to 38 V	22.8		25.2	V
		I_O = 1 to 70 mA, V_I = 33 V	22.8		25.2	
ΔV_O	Line Regulation	V_I = 27 to 38 V, T_J = 25°C			350	mV
		V_I = 28 to 38 V, T_J = 25°C			300	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			200	mV
		I_O =1 to 40 mA, T_J = 25°C			100	
I_d	Quiescent Current	T_J = 25°C			6.5	mA
		T_J = 125°C			6	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 28 to 38 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		200		V
SVR	Supply Voltage Rejection	V_I = 29 to 33 V, f = 120Hz I_O = 40 mA, T_J = 25°C	31	37		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L33

refer to the test circuits, V_I = 36V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	31.68	33	34.32	V
V_O	Output Voltage	I_O = 1 to 40 mA, V_I = 36 to 40 V	31.35		34.65	V
		I_O = 1 to 70 mA, V_I = 38 V	31.35		34.65	
ΔV_O	Line Regulation	V_I = 36 to 40 V, T_J = 25°C			150	mV
		V_I = 37 to 40 V, T_J = 25°C			100	
ΔV_O	Load Regulation	I_O = 1 to 100 mA, T_J = 25°C			60	mV
		I_O =1 to 40 mA, T_J = 25°C			30	
I_d	Quiescent Current	T_J = 25°C			6	mA
		T_J = 125°C			5.5	mA
ΔI_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 36 to 40 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz, T_J = 25°C		120		V
SVR	Supply Voltage Rejection	V_I = 36 to 40 V, f = 120Hz I_O = 40 mA, T_J = 25°C	41	49		dB
V_d	Dropout Voltage			1.7		V

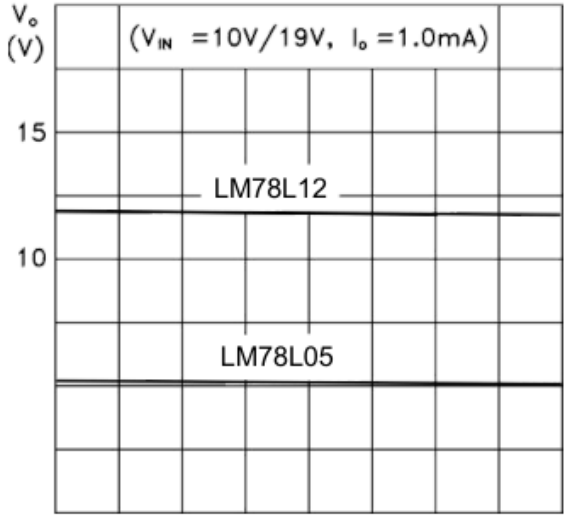


Fig. 1. 78L05/12 Output Voltage vs Ambient Temperature

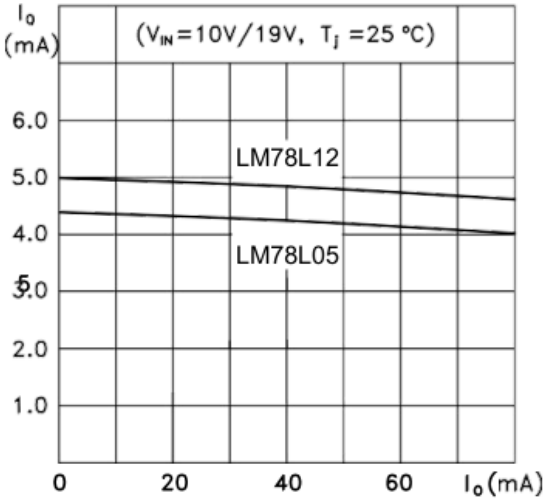
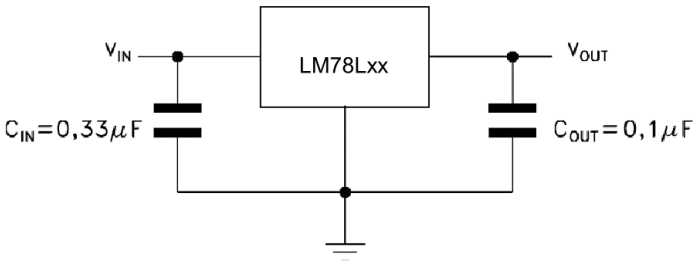
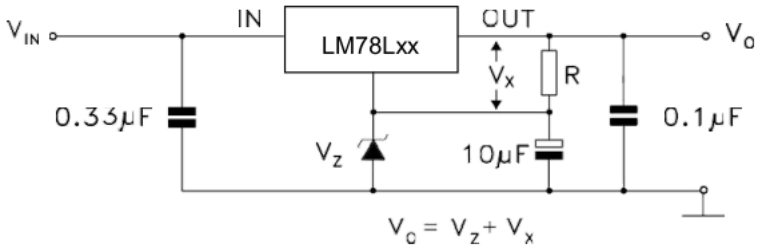


Fig. 2. 78L05/12 Quiescent Current vs Output Current

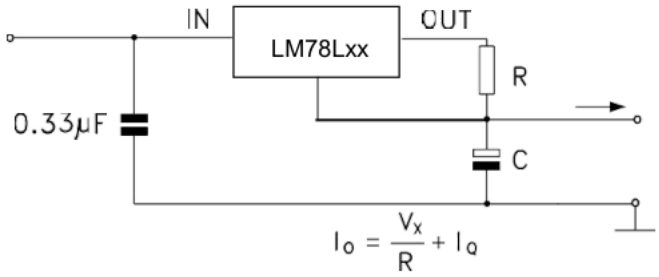
TEST CIRCUITS



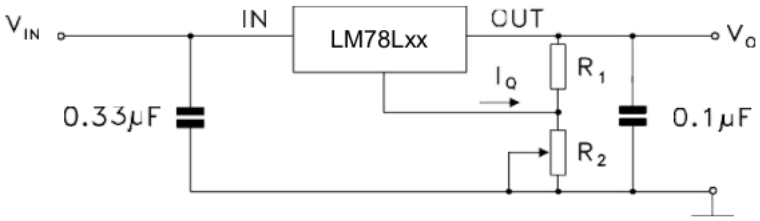
Edit Boost Circuit



Current Regulator

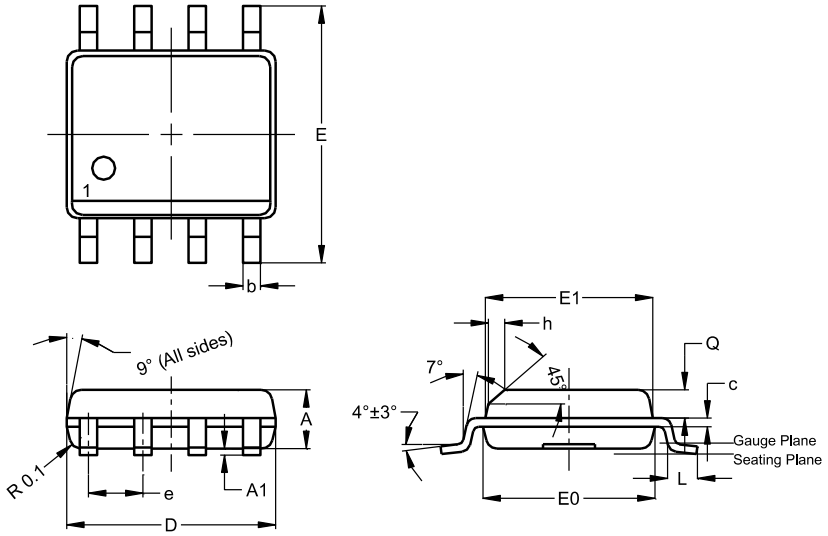


Adjustable Output Regulator



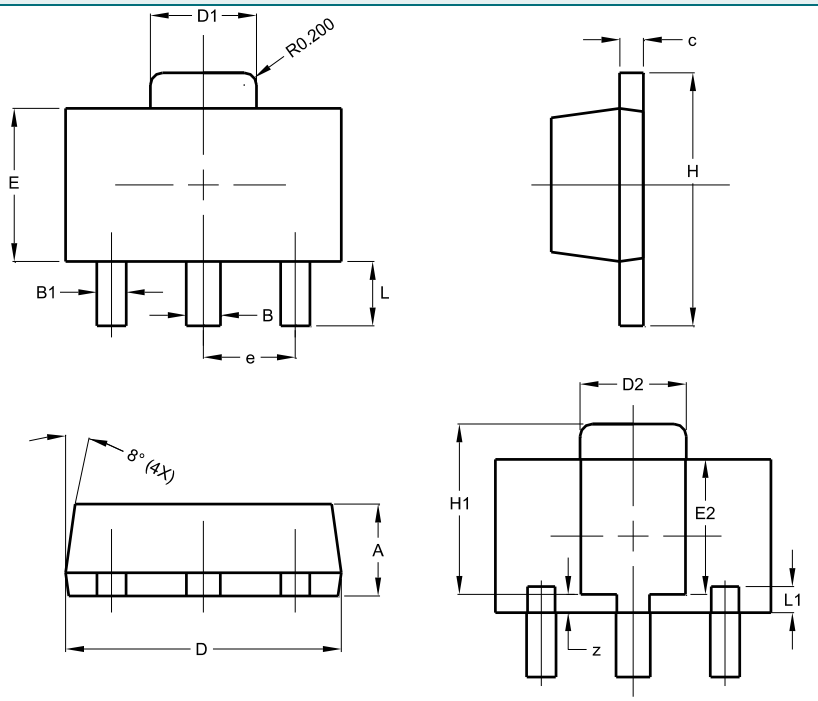
7. Package Outlines

SOP-8



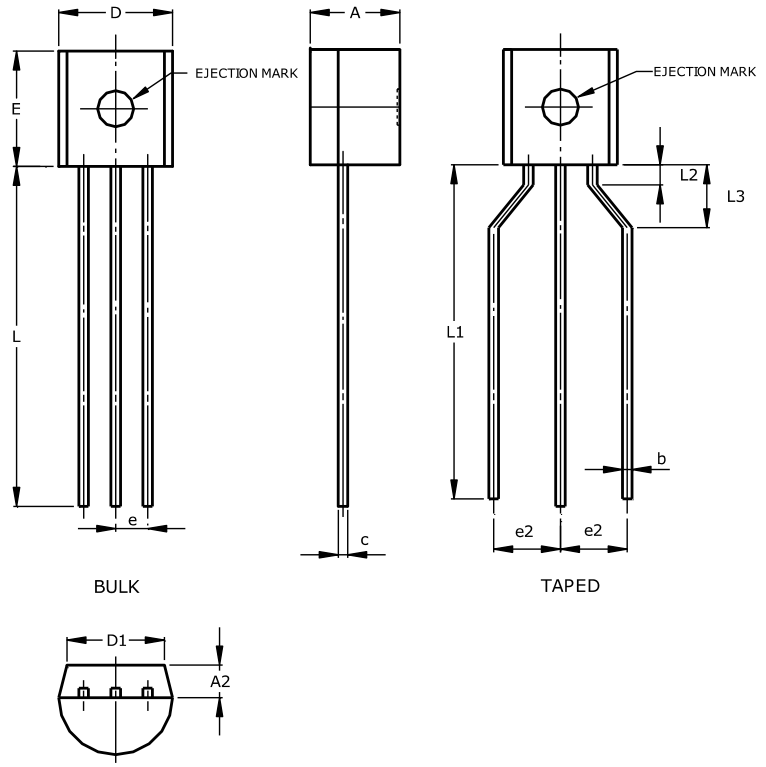
SOP-8			
Dim	Min	Max	Typ
A	1.40	1.50	1.45
A1	0.10	0.20	0.15
b	0.30	0.50	0.40
c	0.15	0.25	0.20
D	4.85	4.95	4.90
E	5.90	6.10	6.00
E1	3.80	3.90	3.85
E0	3.85	3.95	3.90
e	--	--	1.27
h	-	--	0.35
L	0.62	0.82	0.72
Q	0.60	0.70	0.65
All Dimensions in mm			

SOT-89



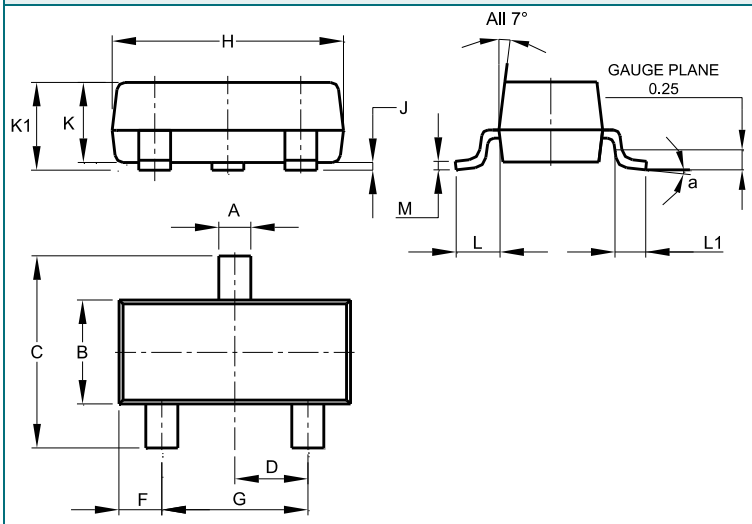
SOT89			
Dim	Min	Max	Typ
A	1.40	1.60	1.50
B	0.50	0.62	0.56
B1	0.42	0.54	0.48
c	0.35	0.43	0.38
D	4.40	4.60	4.50
D1	1.62	1.83	1.733
D2	1.61	1.81	1.71
E	2.40	2.60	2.50
E2	2.05	2.35	2.20
e	-	-	1.50
H	3.95	4.25	4.10
H1	2.63	2.93	2.78
L	0.90	1.20	1.05
L1	0.327	0.527	0.427
z	0.20	0.40	0.30
All Dimensions in mm			

TO-92



TO92			
Dim	Min	Max	Typ
A	3.45	3.66	-
A2	1.22	1.37	-
b	-	-	0.38
c	-	-	0.38
D	4.27	4.78	-
D1	-	-	3.87
E	4.32	4.83	-
e	-	-	1.27
e2	2.40	2.90	-
L	12.98	15.00	-
L1	12.80	15.00	-
L2	0.80	-	-
L3	2.00	3.00	-
All Dimensions in mm			

SOT23-3



SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			

8. Disclaimers

Limited warranty and liability

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