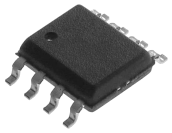
POSITIVE VOLTAGE REGULATORS

DESCRIPTION

The LM78Lxx series of three-terminal positive regulators employ internal current limiting and thermal shutdown, making themessentially 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 twoorders of magnitude, along with lower quiescent current and lower noise.



SOP-8

SOT-89

TO-92

SOT-23-3

FEATURES

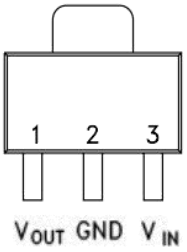
- Output current up to 100 mA
- Output voltages of 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V, 33V.
- Thermal overload protection
- Short circuit protection
- No external components are required
- Availableineither±5%

ORDERING INFORMATION

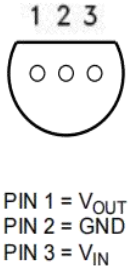
DEVICE	Package Type	MARKING	Packing	Packing Qty
LM78L05ACMK/TR	SOT-89	78L05	REEL	1000pcs/reel
LM78L06ACMK/TR		78L06	REEL	1000pcs/reel
LM78L08ACMK/TR		78L08	REEL	1000pcs/reel
LM78L09ACMK/TR		78L09	REEL	1000pcs/reel
LM78L10ACMK/TR		78L10	REEL	1000pcs/reel
LM78L12ACMK/TR		78L12	REEL	1000pcs/reel
LM78L15ACMK/TR		78L15	REEL	1000pcs/reel
LM78L18ACMK/TR		78L18	REEL	1000pcs/reel
LM78L20ACMK/TR		78L20	REEL	1000pcs/reel
LM78L24ACMK/TR		78L24	REEL	1000pcs/reel
LM78L33ACMK/TR		78L33	REEL	1000pcs/reel

LM78L05ACZ	TO-92	78L05	BAG	1000pcs/bag
LM78L06ACZ		78L06	BAG	1000pcs/bag
LM78L08ACZ		78L08	BAG	1000pcs/bag
LM78L09ACZ		78L09	BAG	1000pcs/bag
LM78L10ACZ		78L10	BAG	1000pcs/bag
LM78L12ACZ		78L12	BAG	1000pcs/bag
LM78L15ACZ		78L15	BAG	1000pcs/bag
LM78L18ACZ		78L18	BAG	1000pcs/bag
LM78L20ACZ		78L20	BAG	1000pcs/bag
LM78L24ACZ		78L24	BAG	1000pcs/bag
LM78L33ACZ		78L33	BAG	1000pcs/bag
LM78L05ACM/TR	SOP-8	78L05A	REEL	2500pcs/reel
LM78L06ACM/TR		78L06A	REEL	2500pcs/reel
LM78L08ACM/TR		78L08A	REEL	2500pcs/reel
LM78L09ACM/TR		78L09A	REEL	2500pcs/reel
LM78L10ACM/TR		78L10A	REEL	2500pcs/reel
LM78L12ACM/TR		78L12A	REEL	2500pcs/reel
LM78L15ACM/TR		78L15A	REEL	2500pcs/reel
LM78L18ACM/TR		78L18A	REEL	2500pcs/reel
LM78L20ACM/TR		78L20A	REEL	2500pcs/reel
LM78L24ACM/TR		78L24A	REEL	2500pcs/reel
LM78L33ACM/TR		78L33A	REEL	2500pcs/reel
LM78L05ACM3/TR	SOT-23-3	78L05	REEL	3000pcs/reel
LM78L06ACM3/TR		78L06	REEL	3000pcs/reel
LM78L08ACM3/TR		78L08	REEL	3000pcs/reel
LM78L09ACM3/TR		78L09	REEL	3000pcs/reel
LM78L10ACM3/TR		78L10	REEL	3000pcs/reel
LM78L12ACM3/TR		78L12	REEL	3000pcs/reel
LM78L15ACM3/TR		78L15	REEL	3000pcs/reel
LM78L18ACM3/TR		78L18	REEL	3000pcs/reel
LM78L20ACM3/TR		78L20	REEL	3000pcs/reel
LM78L24ACM3/TR		78L24	REEL	3000pcs/reel
LM78L33ACM3/TR		78L33	REEL	3000pcs/reel

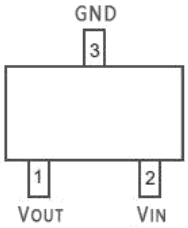
CONNECTION DIAGRAM (top view)



SOT-89-3



TO-92



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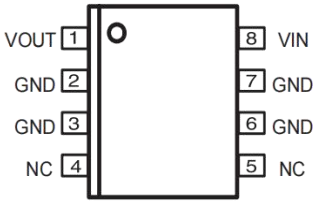


SOP-8

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter²		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_L	Lead Temperature (Soldering, 10 seconds)		245	°C
T_{stg}	Storage Temperature Range		-40 to 150	°C
T_{op}	Operating Junction TemperatureRange		0 to 70	°C

Note:Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured.

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	
V_O	Line Regulation	V_I = 7 to 20 V T_J = 25°C			150	mV
		V_I = 8 to 20 V T_J = 25°C			100	
V_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
I_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 = 12V, 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	
V_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	
V_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
I_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	
V_O	Line Regulation	V_I = 10.5 to 23 V T_J = 25°C			175	mV
		V_I = 11 to 23 V T_J = 25°C			125	
V_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
I_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 23 V 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	
V_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	
V_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
I_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 23 V 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	
V_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	
V_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
I_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 = 14 to 23 V 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	
V_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	
V_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
I_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 25 V 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 = 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	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	
V_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	
V_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
I_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 33V	17.1		18.9	V
		I_O = 1 to 70 mA V_I = 27 V	17.1		18.9	
V_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	
V_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
I_d	Quiescent Current Change	I_O =1 to 40 mA			0.1	mA
		V_I = 23 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 = 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 33V	19		21	V
		I_O = 1 to 70 mA V_I = 29V	19		21	
V_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	
V_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
I_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 = 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	23	24	25	V
V_O	Output Voltage	I_O = 1 to 40 mA V_I = 27 to 38V	22.8		25.2	V
		I_O = 1 to 70 mA V_I = 33 V	22.8		25.2	
V_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	
V_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
I_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 = 23 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 = 3 6 V , 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	
V_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	
V_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
I_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

Figure 1 : 78L05/12 Output Voltage vs Ambient Temperature

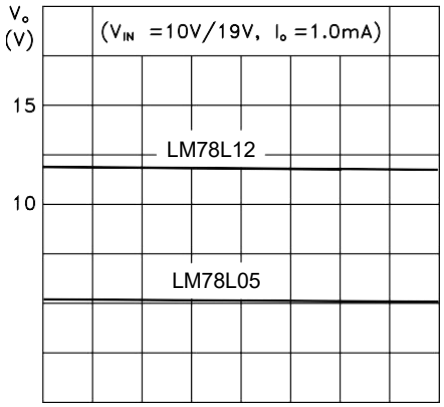
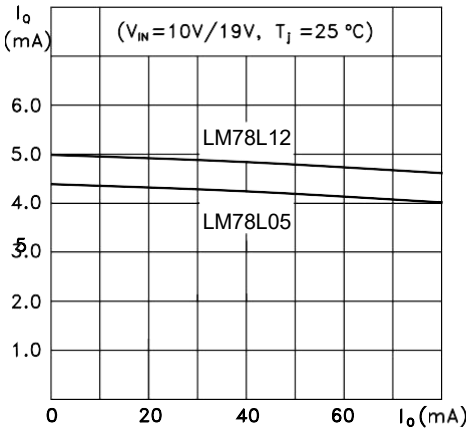
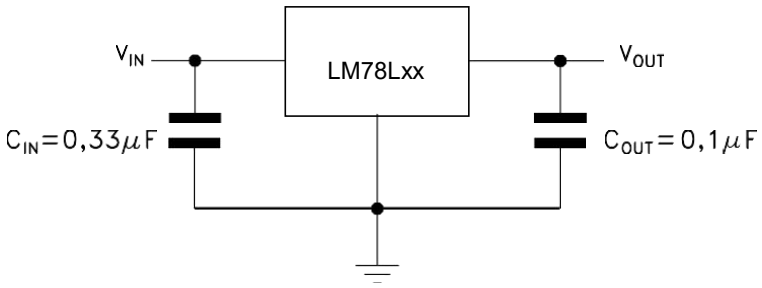


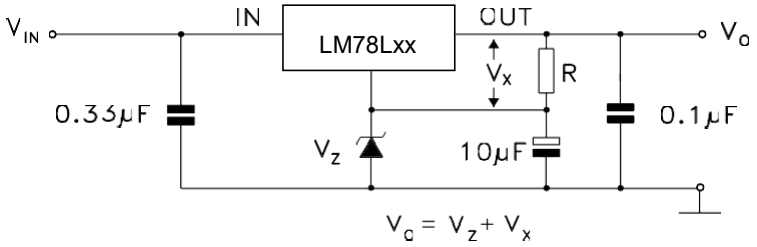
Figure 2: 78L05/12 Quiescent Current vs Output Current



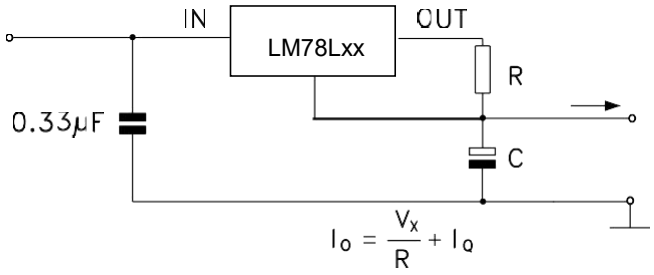
TEST CIRCUITS



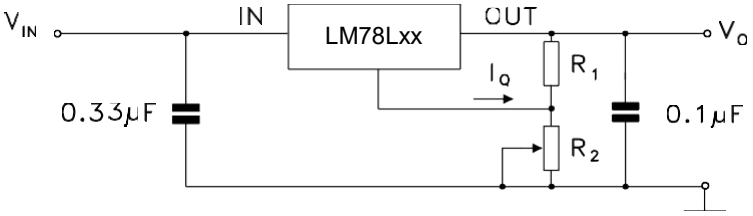
Edit Boost Circuit



Current Regulator

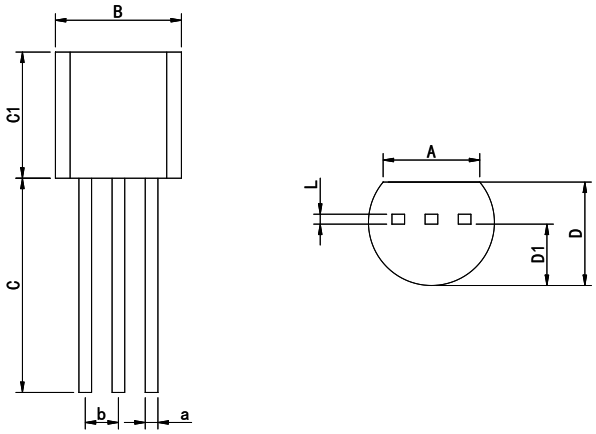


Adjustable Output Regulator



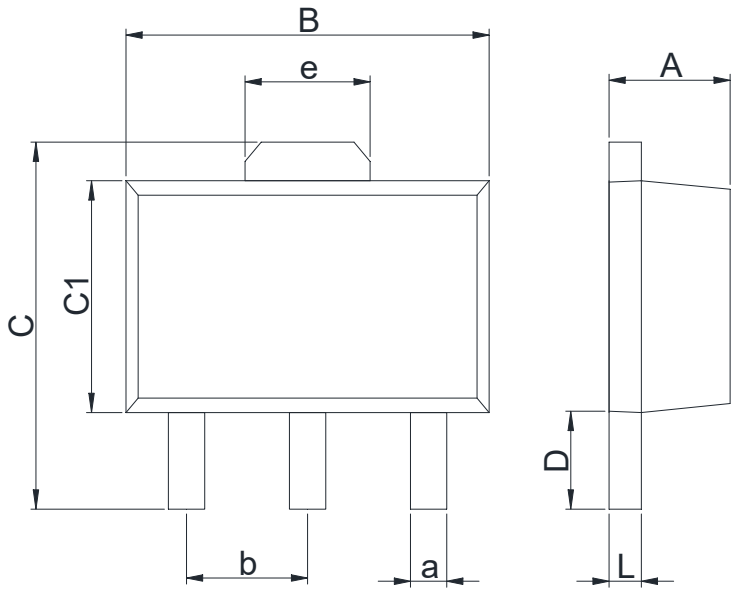
Physical Dimensions

TO-92



Dimensions In Millimeters(TO-92)									
Symbol:	A	B	C	C1	D	D1	L	a	b
Min:	3.43	4.44	13.5	4.32	3.17	2.03	0.33	0.40	1.27BSC
Max:	3.83	5.21	15.3	5.34	4.19	2.67	0.42	0.52	

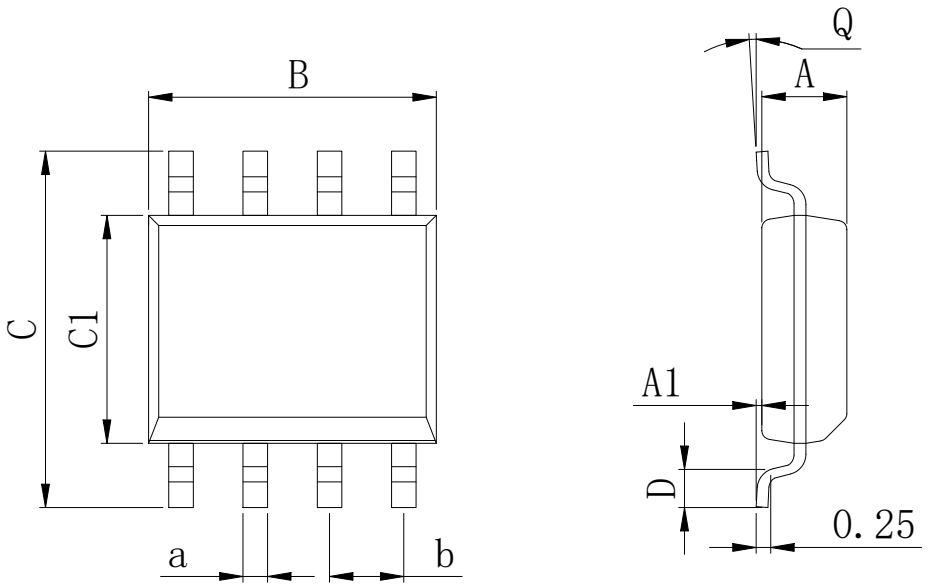
SOT-89-3



Dimensions In Millimeters(SOT-89-3)									
Symbol:	A	B	C	C1	D	L	a	b	e
Min:	1.40	4.40	3.94	2.30	0.90	0.35	0.40	1.50	1.55
Max:	1.60	4.60	4.25	2.60	1.20	0.44	0.50	BSC	BSC

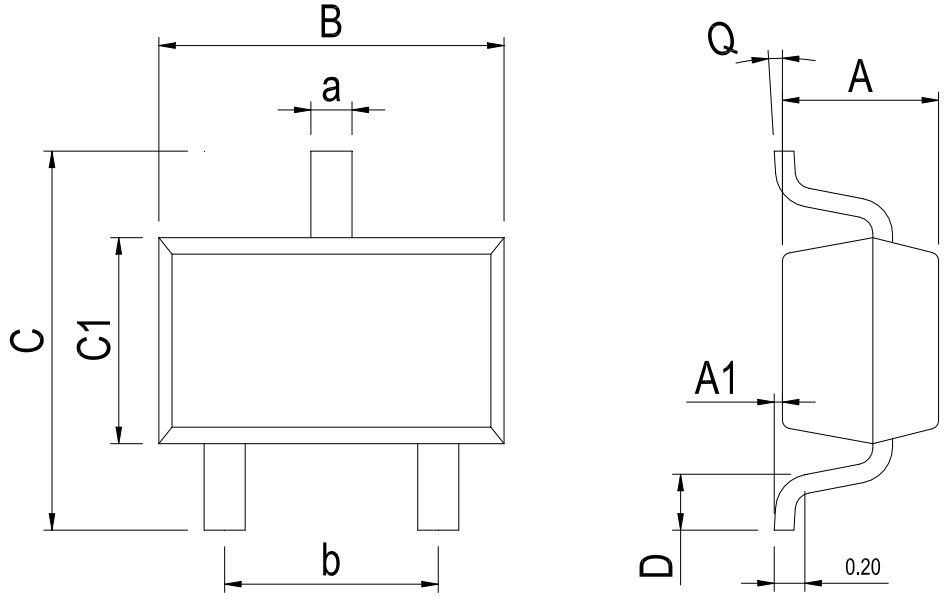
Physical Dimensions

SOP-8



Dimensions In Millimeters(SOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	4.90	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.45	

SOT-23-3



Dimensions In Millimeters(SOT-23-3)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.05	0.00	2.82	2.65	1.50	0.30	0°	0.30	1.90 BSC
Max:	1.15	0.15	3.02	2.95	1.70	0.60	8°	0.40	

Revision History

DATE	REVISION	PAGE
2018-8-9	New	1-14
2023-9-13	Modify the package dimension diagram SOT89-3、Update encapsulation type、Update Lead Temperature、Add annotation for Maximum Ratings.	11、1、3
2024-1-5	Update TO-92 Physical Dimensions	11

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