POSITIVE VOLTAGE REGULATORS

DESCRIPTION

The LM78LxxA 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 LM78LxxA 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

TO-92

SOT-89

SOT-23-3

FEATURES

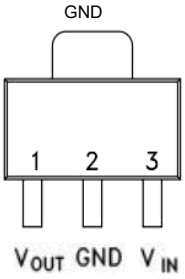
- Output current up to 100 mA
- Output voltages of 3.3V, 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V.
- Thermal overload protection
- Short circuit protection
- No external components are required
- Availableineither ±5%

ORDERING INFORMATION

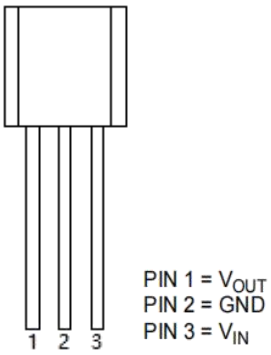
DEVICE	Package Type	MARKING	Packing	Packing Qty
LM78L33ACMK/TR	SOT-89	78L33A	REEL	1000pcs/reel
LM78L05ACMK/TR		78L05A	REEL	1000pcs/reel
LM78L06ACMK/TR		78L06A	REEL	1000pcs/reel
LM78L08ACMK/TR		78L08A	REEL	1000pcs/reel
LM78L09ACMK/TR		78L09A	REEL	1000pcs/reel
LM78L10ACMK/TR		78L10A	REEL	1000pcs/reel
LM78L12ACMK/TR		78L12A	REEL	1000pcs/reel
LM78L15ACMK/TR		78L15A	REEL	1000pcs/reel
LM78L18ACMK/TR		78L18A	REEL	1000pcs/reel
LM78L20ACMK/TR		78L20A	REEL	1000pcs/reel
LM78L24ACMK/TR		78L24A	REEL	1000pcs/reel

LM78L33ACZ	TO-92	78L33A,78L33,LM78L33	BAG	1000pcs/bag
LM78L05ACZ		78L05A	BAG	1000pcs/bag
LM78L06ACZ		78L06A	BAG	1000pcs/bag
LM78L08ACZ		78L08A	BAG	1000pcs/bag
LM78L09ACZ		78L09A	BAG	1000pcs/bag
LM78L10ACZ		78L10A	BAG	1000pcs/bag
LM78L12ACZ		78L12A	BAG	1000pcs/bag
LM78L15ACZ		78L15A	BAG	1000pcs/bag
LM78L18ACZ		78L18A	BAG	1000pcs/bag
LM78L20ACZ		78L20A	BAG	1000pcs/bag
LM78L24ACZ		78L24A	BAG	1000pcs/bag
LM78L33ACM/TR	SOP-8	78L33AC	REEL	2500pcs/reel
LM78L05ACM/TR		78L05AC	REEL	2500pcs/reel
LM78L06ACM/TR		78L06AC	REEL	2500pcs/reel
LM78L08ACM/TR		78L08AC	REEL	2500pcs/reel
LM78L09ACM/TR		78L09AC	REEL	2500pcs/reel
LM78L10ACM/TR		78L10AC	REEL	2500pcs/reel
LM78L12ACM/TR		78L12AC	REEL	2500pcs/reel
LM78L15ACM/TR		78L15AC	REEL	2500pcs/reel
LM78L18ACM/TR		78L18AC	REEL	2500pcs/reel
LM78L20ACM/TR		78L20AC	REEL	2500pcs/reel
LM78L24ACM/TR		78L24AC	REEL	2500pcs/reel
LM78L33ACM3/TR	SOT-23-3	78L33A	REEL	3000pcs/reel
LM78L05ACM3/TR		78L05A	REEL	3000pcs/reel
LM78L06ACM3/TR		78L06A	REEL	3000pcs/reel
LM78L08ACM3/TR		78L08A	REEL	3000pcs/reel
LM78L09ACM3/TR		78L09A	REEL	3000pcs/reel
LM78L10ACM3/TR		78L10A	REEL	3000pcs/reel
LM78L12ACM3/TR		78L12A	REEL	3000pcs/reel
LM78L15ACM3/TR		78L15A	REEL	3000pcs/reel
LM78L18ACM3/TR		78L18A	REEL	3000pcs/reel
LM78L20ACM3/TR		78L20A	REEL	3000pcs/reel
LM78L24ACM3/TR		78L24A	REEL	3000pcs/reel

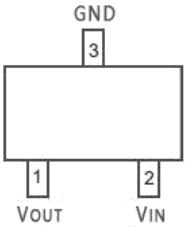
CONNECTION DIAGRAM (top view)



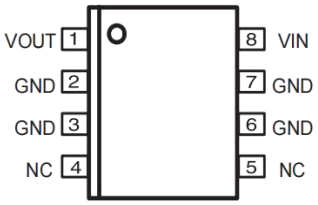
SOT-89-3



TO-92

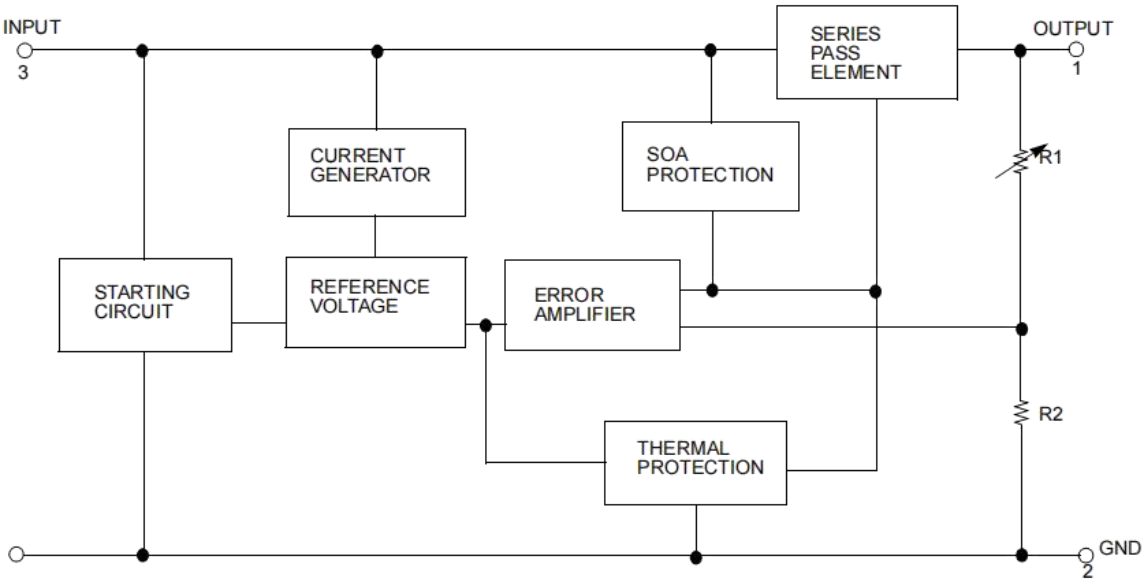


SOT-23-3



SOP-8

INTERNAL BLOCK DIGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter[2]		Value	Unit
V_I	DC Input Voltage	V_O = 3.3 to 10 V	30	V
		V_O = 12 to 15 V	35	
		V_O = 18 to 24 V	40	
I_O	Output Current		100	mA
P_{tot}	Power Dissipation		Internally Limited (*)	
T_L	Lead Temperature (Soldering, 10 seconds)		260	°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 LM78L33A

refer to the test circuits, V_I = 8.3V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,unless otherwise specified.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_O	Output Voltage	T_J = 25°C	3.168	3.3	3.432	V
V_O	Output Voltage	I_O = 1 to 40 mA V_I = 5.3 to 20 V	3.135		3.465	V
		I_O = 1 to 70 mA V_I = 8.3 V	3.135		3.465	
V_O	Line Regulation	V_I = 5.3 to 20 V T_J = 25°C			150	mV
		V_I = 6.3 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			0.2	mA
		V_I = 6.3 to 20 V			1.5	
eN	Output Noise Voltage	B =10Hz to 100KHz T_J = 25°C		40		μV
SVR	Supply Voltage Rejection	V_I = 6.3 to 16.3 V f = 120Hz I_O = 40 mA T_J = 25°C	41	49		dB
V_d	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L05A

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

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		μV
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 LM78L06A

refer to the test circuits, V_I = 12V, I_O = 40 mA, C_I = 0.33 μF, C_O = 0.1 μF,unless otherwise specified.

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		μV
SVR	Supply Voltage Rejection	V_I = 9 to 20 V f = 120Hz I_O = 40 mA T_J = 25°C	39	46		dB
Vd	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L08A

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

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		μV
SVR	Supply Voltage Rejection	V_I = 12 to 23 V f = 120Hz I_O = 40 mA T_J = 25°C	37	45		dB
Vd	Dropout Voltage			1.7		V

ELECTRICAL CHARACTERISTICS OF LM78L09A

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

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		μV
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 LM78L10A

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

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		μV
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 LM78L12A

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

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		μV
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 LM78L15A

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

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		μV
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 LM78L18A

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

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		μV
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 LM78L20A

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

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		μV
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 LM78L24A

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

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		μV
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

Figure 1 : LM78L05/12 Output Voltage vs Ambient Temperature

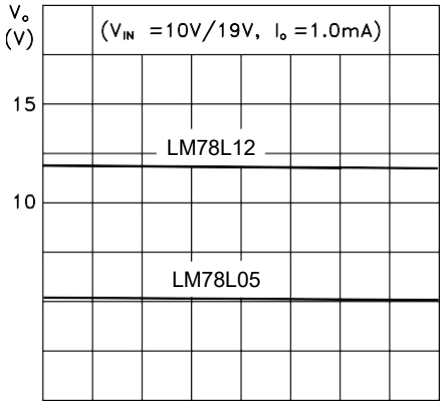
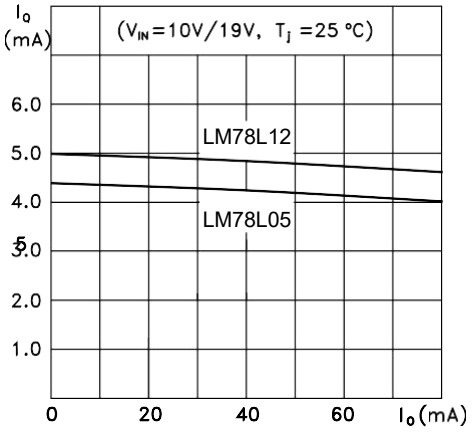
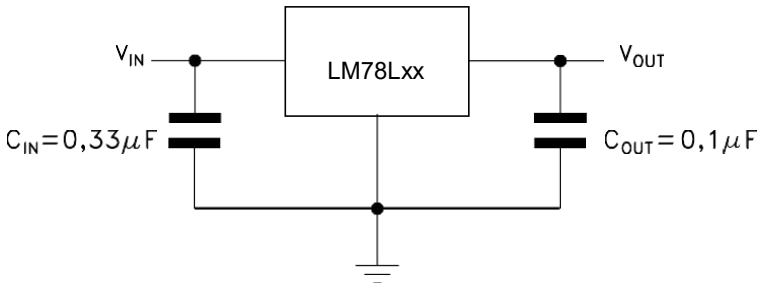


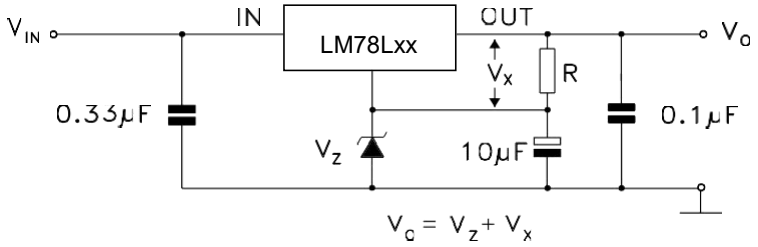
Figure 2: LM78L05/12 Quiescent Current vs Output Current



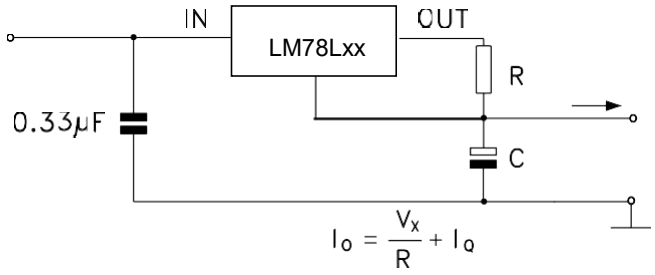
TEST CIRCUITS



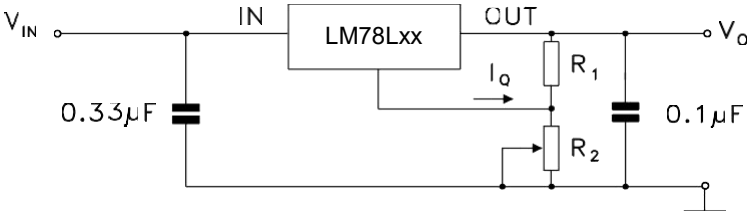
Edit Boost Circuit



Current Regulator

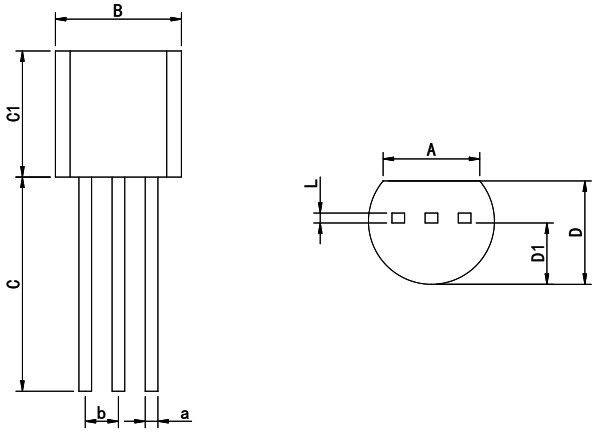


Adjustable Output Regulator



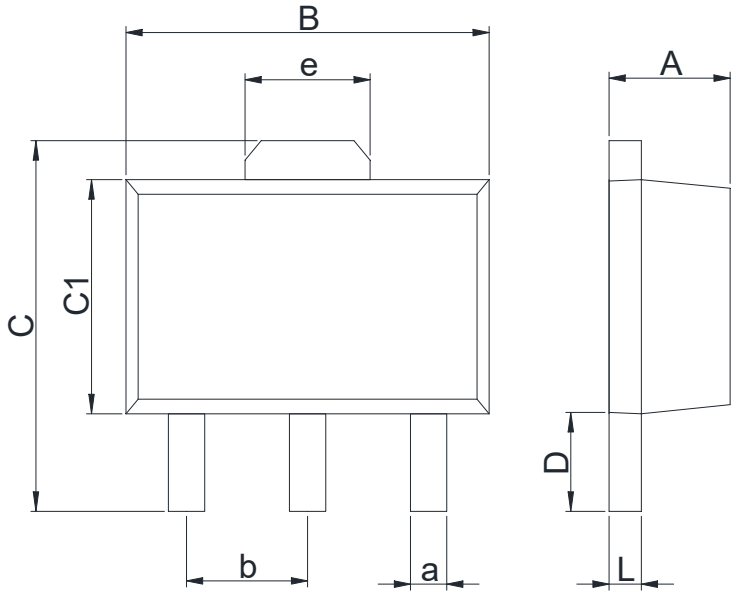
PHYSICAL DIMENSIONS

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:	4.13	5.21	15.3	5.34	4.19	2.67	0.42	0.52	

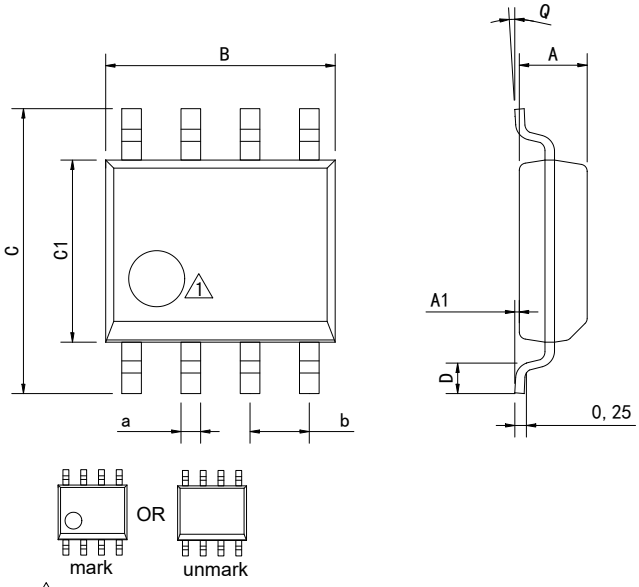
SOT-89-3



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

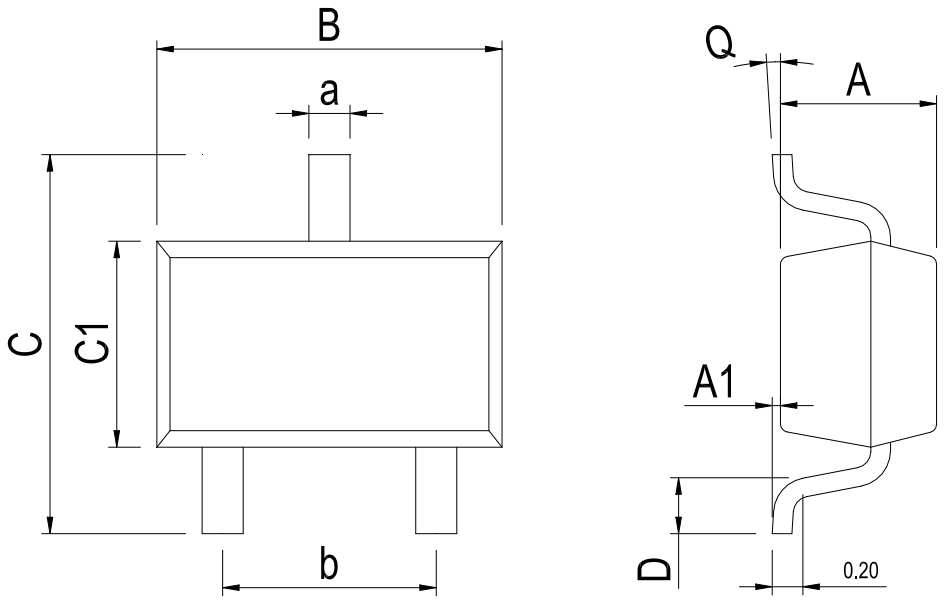
SOP-8



1 Package top mark may be in lower left corner or unmark

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:	1.00	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°	0.50	

REVISION HISTORY

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2016-8	New	1-14
V1.1	2021-9	Modify the package dimension diagram SOT89-3、Update encapsulation type	1、11
V1.2	2024-4	Update SOT-23-3 Physical dimension and Lead Temperature	12、3
V1.3	2025-6	Add MARKING	2
V1.4	2025-7	Add Internal Block Digram	3
V1.5	2025-12	Update important statements、Update sop-8 Dimension drawing	13、15

IMPORTANT STATEMENT:

Huaguan Semiconductor reserves the right to change products and services offered without prior notice. Customers should obtain the latest relevant information before placing orders and verify that such information is current and complete. Huaguan Semiconductor assumes no responsibility or liability for altered documents.

Customers are responsible for complying with safety standards and implementing safety measures when using Huaguan Semiconductor products in system design and end-product manufacturing. You assume full responsibility for: selecting the appropriate Huaguan Semiconductor products for your application; designing, validating, and testing your application; and ensuring that your application complies with applicable standards and all other safety, security, or other requirements. This is to prevent potential risks that may lead to personal injury or property damage.

Huaguan Semiconductor products are not approved for use in life support, military, aerospace, or other high-risk applications. Huaguan products are neither intended nor warranted for use in such systems or equipment. Any failure or malfunction may lead to personal injury or severe property damage. Such applications are deemed "Unsafe Use." Unsafe Use includes, but is not limited to: surgical and medical equipment, nuclear energy control equipment, aircraft or spacecraft instruments, control or operation of vehicle power, braking, or safety systems, traffic signal instruments, all types of safety devices, and any other applications intended to support or sustain life. Huaguan Semiconductor shall not be liable for consequences resulting from Unsafe Use in these fields. Users must independently evaluate and assume all risks. Any issues, liabilities, or losses arising from the use of products beyond their approved applications shall be solely borne by the user. Users may not claim any compensation from Huaguan Semiconductor based on these terms. If any third party claims against Huaguan Semiconductor due to such Unsafe Use, the user shall compensate Huaguan Semiconductor for all resulting damages and liabilities.

Huaguan Semiconductor provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources for its semiconductor products. However, no guarantee is made that these resources are free from defects, and no express or implied warranties are provided. The use of testing and other quality control techniques is limited to Huaguan Semiconductor's quality assurance scope. Not all parameters of each device are tested.

Huaguan Semiconductor's documentation authorizes you to use these resources only for developing applications related to the products described herein. You are not granted rights to any other intellectual property of Huaguan Semiconductor or any third party. Any other reproduction or display of these resources is strictly prohibited. You shall fully indemnify Huaguan Semiconductor and its agents against any claims, damages, costs, losses, and liabilities arising from your use of these resources. Huaguan Semiconductor shall not be held responsible.