

100mA Positive Voltage Regulator

General Description

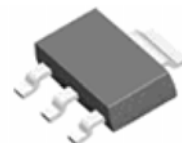
- The TCI LM78LXX family is monolithic fixed voltage regulator integrated circuit. They are suitable for applications that required supply current up to 100mA.
- The LM78L is available in TO-92, SOT-89, SOT-223 and SOP-8 packages.



TO-92



SOT-89



SOT-223



SOP-8



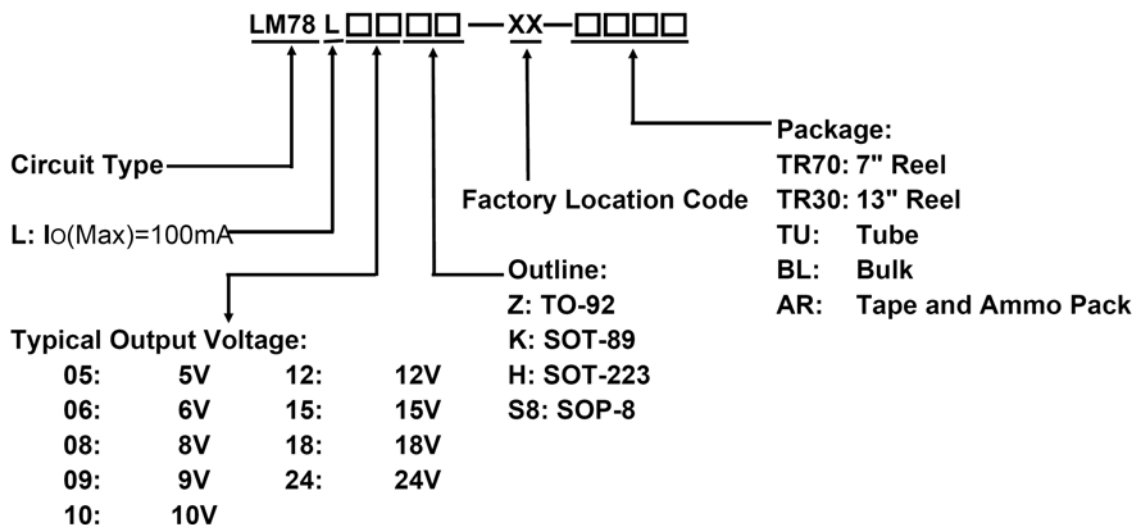
Features

- Output Current up to 100mA
- Fixed output voltage of 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V and 24V available
- Thermal overload shutdown protection
- Short circuit current limiting
- RoHS Compliance

Applications

- Consumer Electronics
- Microprocessor Power Supply
- Mother Board

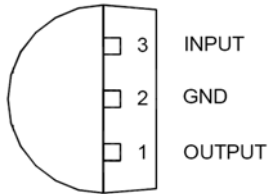
Ordering Information



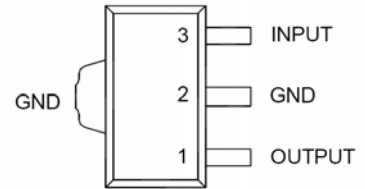
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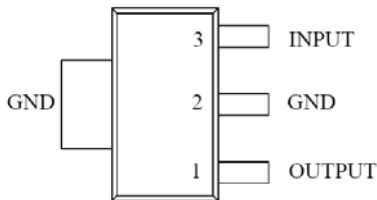
Pin Configuration



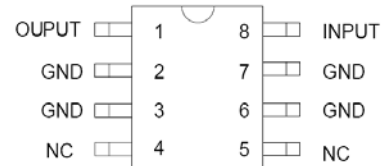
**Outline: Z
TO-92**



**Outline: K
SOT-89**

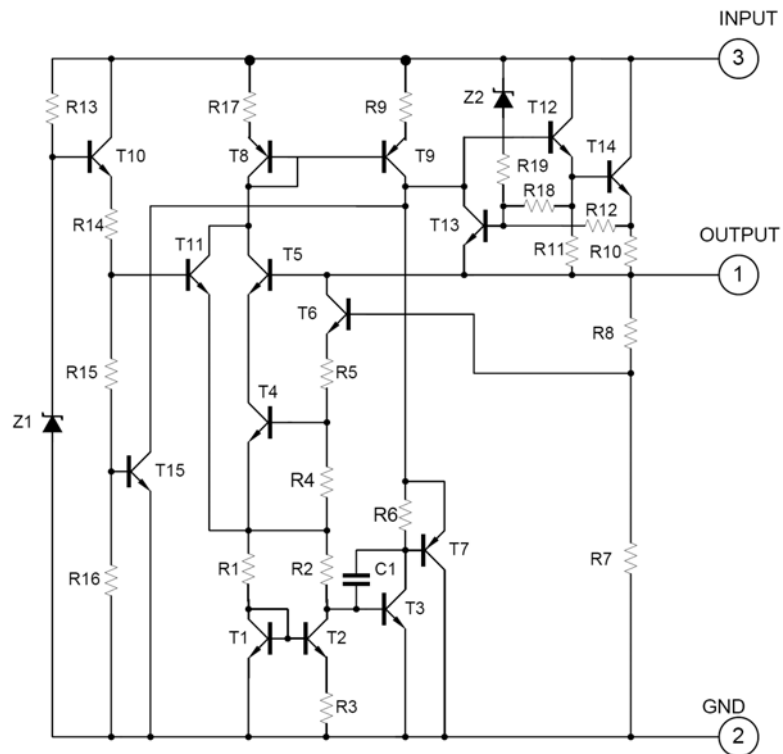


**Outline: H
SOT-223**



**Outline: S8
SOP-8**

Block Diagram



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Absolute Maximum Ratings

Symbol	Description	Ratings	Unit	
V _{IN}	Input Voltage	V _{OUT} =5~9V	30	V
		V _{OUT} =12~24V	35	
I _{OUT}	Output Current	100	mA	
P _D	Power Dissipation	SOP-8	300	mW
		SOT-223	325	
		SOT-89	350	
		TO-92	625	
T _J	Junction Temperature	125	°C	
T _{OPR}	Operating Temperature Range	0 ~ 125	°C	
T _{STG}	Storage Temperature Range	-55 ~ 150	°C	

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

Electrical Characteristics

For LM78L05 (V_{IN}=10V, I_{OUT}=40mA, 0° C<T_J<125° C, C₁=0.33μF, C_o =0.1μF, unless otherwise specified)

Symbol	Description	LM78L05			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	4.80	5.0	5.20	V	T _J =25°C
		4.75	-	5.25	V	7V ≤ V _{IN} ≤ 20V, I _{OUT} =1mA-40mA
		4.75	-	5.25	V	7V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	11	60	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	5.0	30	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 40mA
ΔV _{OUT}	Line Regulation	-	8	150	mV	T _J =25°C, 7V ≤ V _{IN} ≤ 20V
		-	6	100	mV	T _J =25°C, 8V ≤ V _{IN} ≤ 20V
I _Q	Quiescent Current	-	2.0	5.5	mA	V _{IN} =10V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	8V ≤ V _{IN} ≤ 20V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	40	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-0.65	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	41	80	-	dB	8V ≤ V _{IN} ≤ 20V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

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For LM78L06 ($V_{IN}=12V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L06			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	5.76	6.0	6.24	V	T _J =25°C
		5.70	-	6.30	V	8.5V ≤ V _{IN} ≤ 20V, I _{OUT} =1mA-40mA
		5.70	-	6.30	V	8.5V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	12.8	80	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	5.8	40	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 70mA
ΔV _{OUT}	Line Regulation	-	64	175	mV	T _J =25°C, 8.5V ≤ V _{IN} ≤ 20V
		-	54	125	mV	T _J =25°C, 9V ≤ V _{IN} ≤ 20V
I _Q	Quiescent Current	-	3.9	6.0	mA	V _{IN} =12V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	9V ≤ V _{IN} ≤ 20V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	49	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-0.75	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	40	46	-	dB	10V ≤ V _{IN} ≤ 20V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

For LM78L08 ($V_{IN}=14V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L08			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	7.68	8.0	8.32	V	T _J =25°C
		7.60	-	8.40	V	10.5V ≤ V _{IN} ≤ 23V, I _{OUT} =1mA-40mA
		7.60	-	8.40	V	10.5V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	15	80	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	8.0	40	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 70mA
ΔV _{OUT}	Line Regulation	-	10	175	mV	T _J =25°C, 10.5V ≤ V _{IN} ≤ 23V
		-	8	125	mV	T _J =25°C, 11V ≤ V _{IN} ≤ 23V
I _Q	Quiescent Current	-	2.0	5.5	mA	V _{IN} =14V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	11V ≤ V _{IN} ≤ 23V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	49	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-0.75	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	39	70	-	dB	11V ≤ V _{IN} ≤ 23V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

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For LM78L09 ($V_{IN}=15V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L09			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	8.64	9.0	9.36	V	T _J =25°C
		8.55	-	9.45	V	11.5V ≤ V _{IN} ≤ 24V, I _{OUT} =1mA-40mA
		8.55	-	9.45	V	11.5V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	20	90	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	10	45	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 40mA
ΔV _{OUT}	Line Regulation	-	90	200	mV	T _J =25°C, 11.5V ≤ V _{IN} ≤ 24V
		-	100	150	mV	T _J =25°C, 13V ≤ V _{IN} ≤ 24V
I _Q	Quiescent Current	-	2.0	6.0	mA	V _{IN} =15V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	13V ≤ V _{IN} ≤ 24V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	70	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-0.75	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	38	44	-	dB	12V ≤ V _{IN} ≤ 24V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

For LM78L10 ($V_{IN}=16V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L10			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	9.6	10.0	10.4	V	T _J =25°C
		9.5	-	10.5	V	12.5V ≤ V _{IN} ≤ 25V, I _{OUT} =1mA-40mA
		9.5	-	10.5	V	12.5V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	20	94	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	10	47	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 70mA
ΔV _{OUT}	Line Regulation	-	100	200	mV	T _J =25°C, 12.5V ≤ V _{IN} ≤ 25V
		-	100	170	mV	T _J =25°C, 14V ≤ V _{IN} ≤ 25V
I _Q	Quiescent Current	-	2.0	6.0	mA	V _{IN} =17V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	12.5V ≤ V _{IN} ≤ 25V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	74	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-0.8	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	38	43	-	dB	15V ≤ V _{IN} ≤ 25V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

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For LM78L12 ($V_{IN}=19V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L12			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	11.52	12.00	12.48	V	T _J =25°C
		11.40	-	12.60	V	14.5V ≤ V _{IN} ≤ 27V, I _{OUT} =1mA-40mA
		11.40	-	12.60	V	14.5V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	25	150	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	12	75	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 40mA
ΔV _{OUT}	Line Regulation	-	25	300	mV	T _J =25°C, 14.5V ≤ V _{IN} ≤ 27V
		-	20	250	mV	T _J =25°C, 16V ≤ V _{IN} ≤ 27V
I _Q	Quiescent Current	-	2.0	6.0	mA	V _{IN} =19V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	16V ≤ V _{IN} ≤ 27V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	80	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-1.0	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	37	65	-	dB	15V ≤ V _{IN} ≤ 25V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

For LM78L15 ($V_{IN}=23V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L15			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	14.40	15.00	15.60	V	T _J =25°C
		14.25	-	15.75	V	17.5V ≤ V _{IN} ≤ 30V, I _{OUT} =1mA-40mA
		14.25	-	15.75	V	17.5V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	20	150	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	25	150	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 70mA
ΔV _{OUT}	Line Regulation	-	25	150	mV	T _J =25°C, 17.5V ≤ V _{IN} ≤ 30V
		-	15	75	mV	T _J =25°C, 20V ≤ V _{IN} ≤ 30V
I _Q	Quiescent Current	-	2.2	6.5	mA	V _{IN} =23V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	20V ≤ V _{IN} ≤ 30V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	90	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-1.3	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	34	63	-	dB	18.5V ≤ V _{IN} ≤ 28.5V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

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For LM78L18 ($V_{IN}=27V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L18			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	17.28	18.00	18.72	V	T _J =25°C
		17.10	-	18.90	V	21V ≤ V _{IN} ≤ 33V, I _{OUT} =1mA-40mA
		17.10	-	18.90	V	21V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	30	170	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	15	85	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 40mA
ΔV _{OUT}	Line Regulation	-	145	300	mV	T _J =25°C, 21V ≤ V _{IN} ≤ 33V
		-	135	250	mV	T _J =25°C, 22V ≤ V _{IN} ≤ 33V
I _Q	Quiescent Current	-	2.0	6.0	mA	V _{IN} =27V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	21V ≤ V _{IN} ≤ 33V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	150	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-1.8	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	34	48	-	dB	23V ≤ V _{IN} ≤ 33V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

For LM78L24 ($V_{IN}=33V$, $I_{OUT}=40mA$, $0^{\circ}C < T_J < 125^{\circ}C$, $C_1=0.33\mu F$, $C_o=0.1\mu F$, unless otherwise specified)

Symbol	Description	LM78L24			Unit	Test Conditions
		Min.	Typ.	Max.		
V _{OUT}	Output Voltage	23.04	24.00	24.96	V	T _J =25°C
		22.8	-	25.2	V	27V ≤ V _{IN} ≤ 38V, I _{OUT} =1mA-40mA
		22.8	-	25.2	V	27V ≤ V _{IN} ≤ V _{MAX} , I _{OUT} =1mA-70mA Power Dissipation < 0.5W
ΔV _{OUT}	Load Regulation	-	40	200	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 100mA
		-	20	100	mV	T _J =25°C, 1mA ≤ I _{OUT} ≤ 40mA
ΔV _{OUT}	Line Regulation	-	160	300	mV	T _J =25°C, 27V ≤ V _{IN} ≤ 38V
		-	150	250	mV	T _J =25°C, 28V ≤ V _{IN} ≤ 38V
I _Q	Quiescent Current	-	2.2	6.0	mA	V _{IN} =33V, I _{OUT} =0mA, T _J =25°C
ΔI _Q	Quiescent Current Change	-	-	1.5	mA	27V ≤ V _{IN} ≤ 38V
		-	-	0.1	mA	1mA ≤ I _{IN} ≤ 40mA
e _N	Output Noise Voltage	-	200	-	μV	10Hz ≤ f ≤ 100KHz
ΔV _O /ΔT	Temperature coefficient of V _{OUT}	-	-2.0	-	mV/°C	I _{OUT} =5mA
RR	Ripple Rejection	34	45	-	dB	27V ≤ V _{IN} ≤ 38V, f=120Hz, T _J =25°C
V _D	Dropout Voltage	-	1.7	-	V	T _J =25°C

Note: The maximum steady state usable output current is dependent on input voltage, heat sinking, lead length of the package and copper pattern of PCB.

Typical Characteristics Curves

Fig.1- Ambient temperature vs. Power dissipation

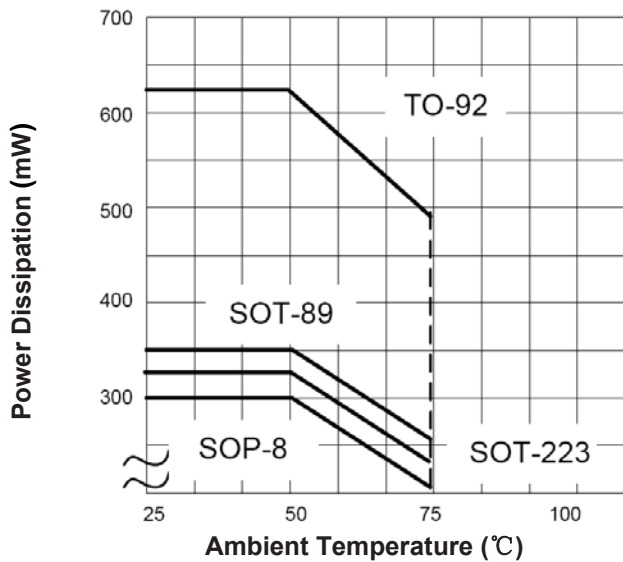


Fig.2- LM78L05 Output Voltage vs. Ambient Temperature

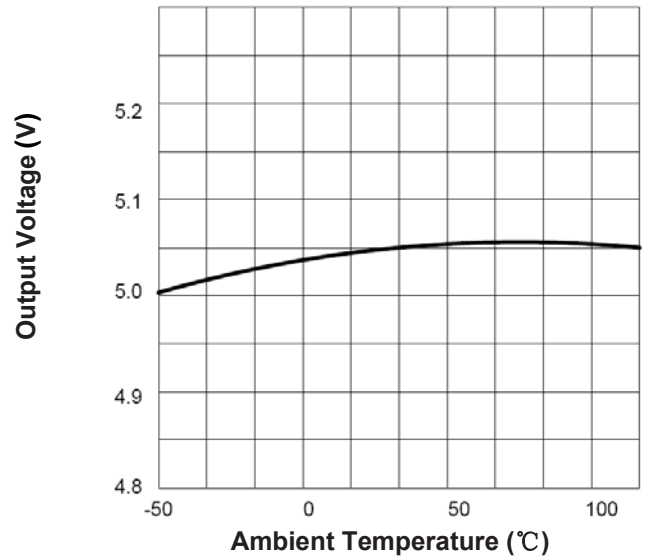


Fig.3- LM78L12 Output Voltage vs. Ambient Temperature

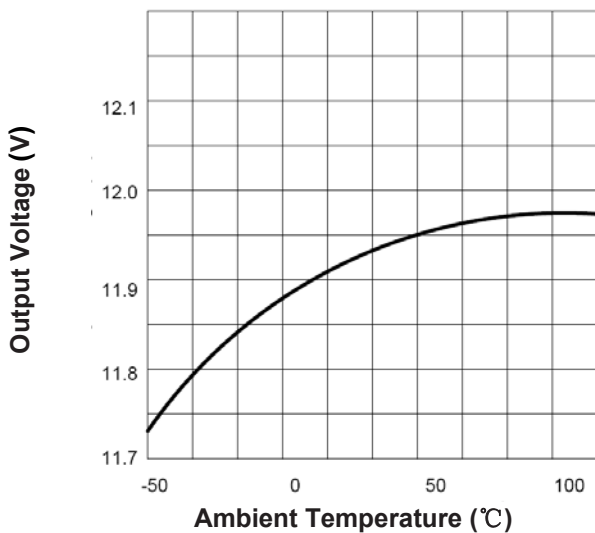
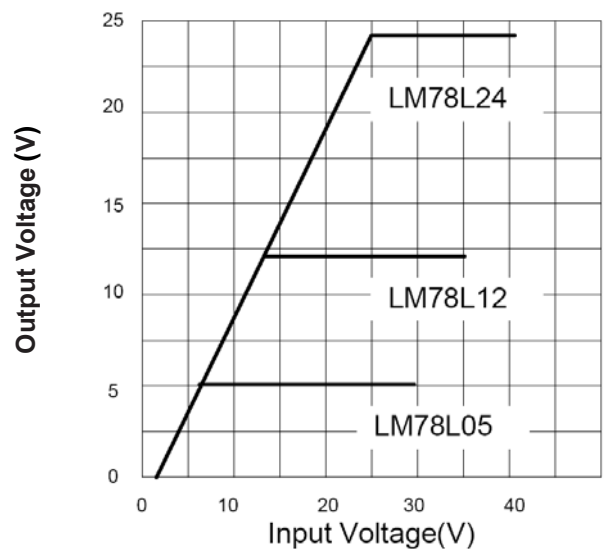


Fig.4- Output Characteristics (I_p=0mA, T_j=25°C)



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Typical Characteristics Curves (Continued)

Fig.5- LM78L05 Dropout Characteristics (T_j=25°C)

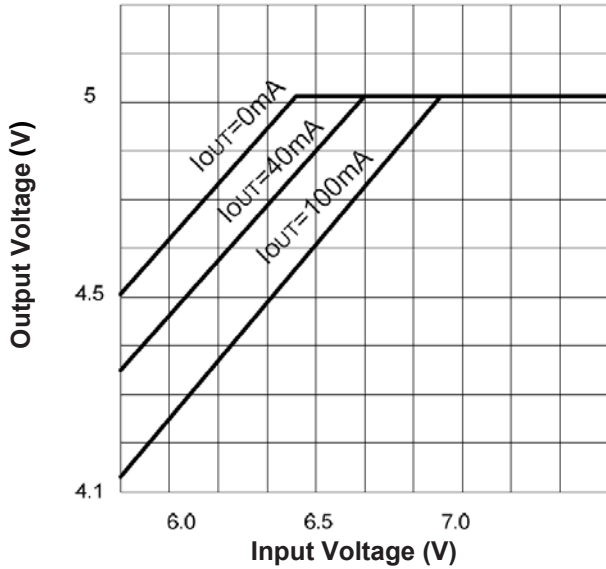


Fig.6- Short Circuit Output Current (T_j=25°C)

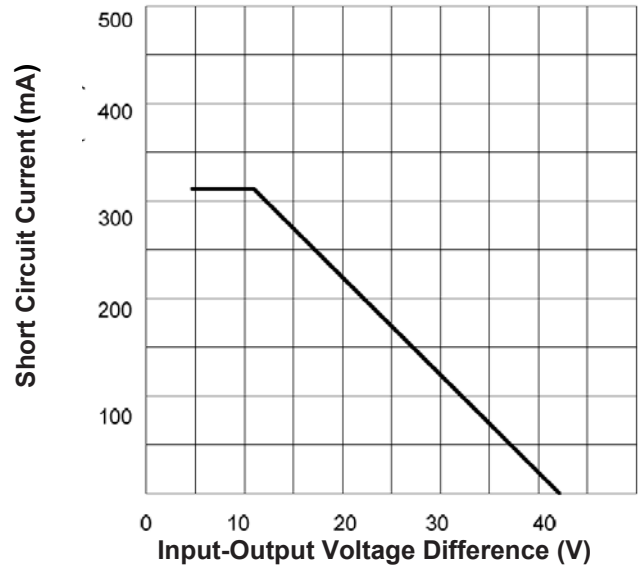


Fig.7- LM78L12/24 Quiescent Current vs. Output Current (T_j=25°C)

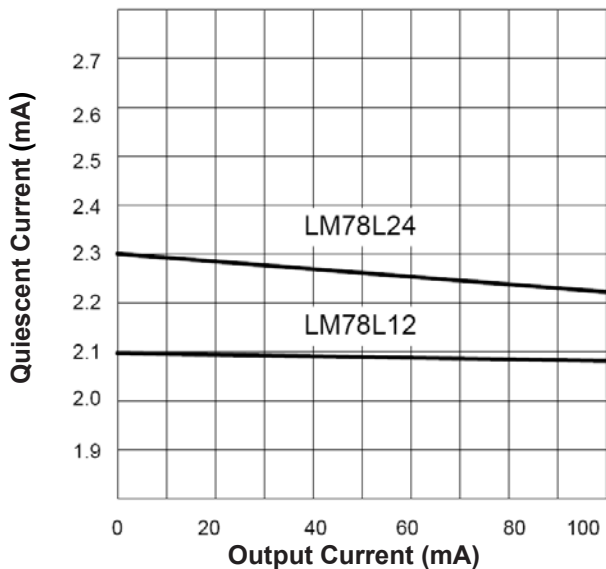
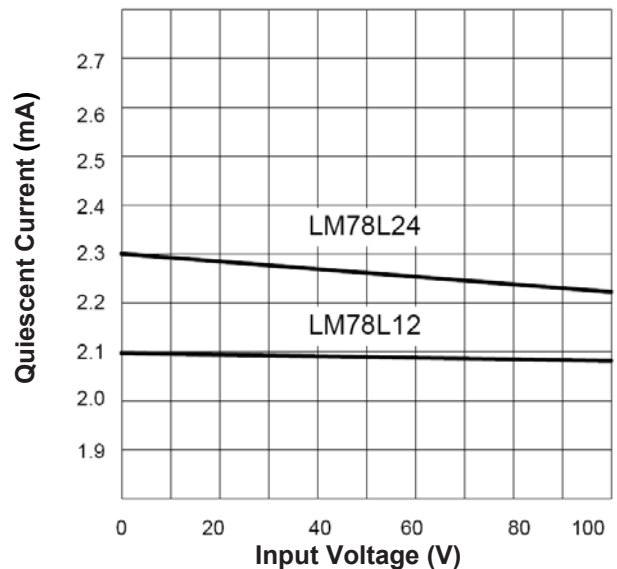


Fig.8- LM78L05 Quiescent Current vs. Input Voltage (I_{OUT}=0mA, T_j=25°C)



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LM78L

Typical Characteristics Curves (Continued)

Fig.9- Peak Output Current vs. Dropout Voltage Difference

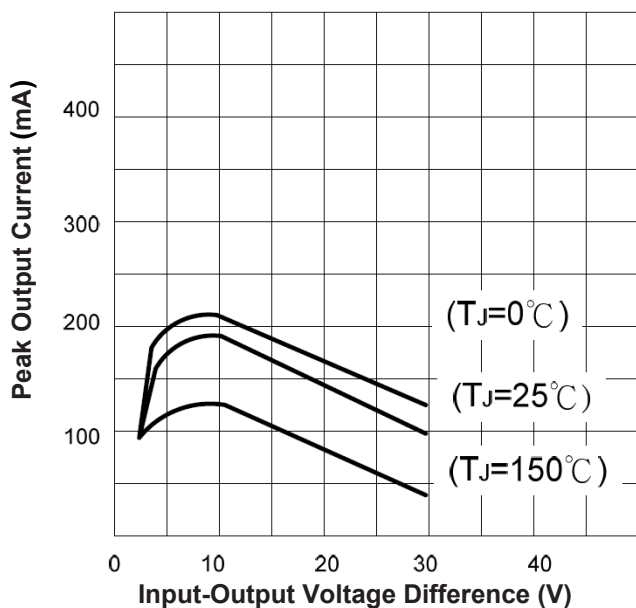
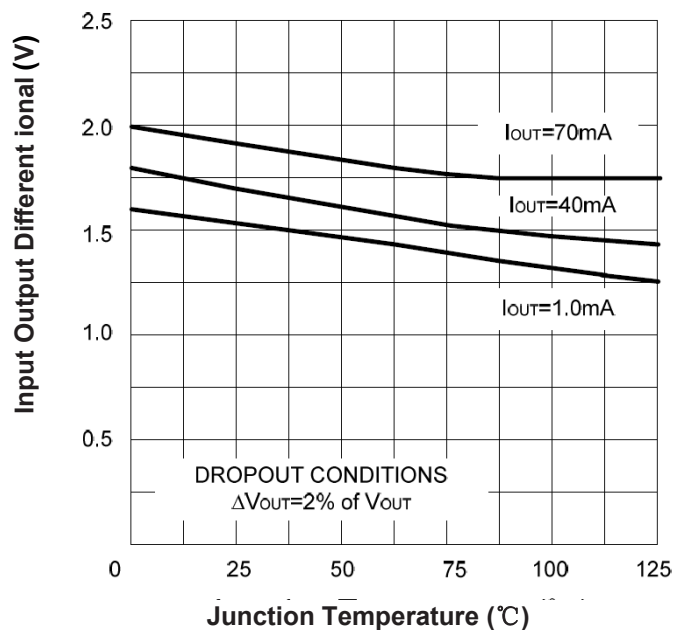
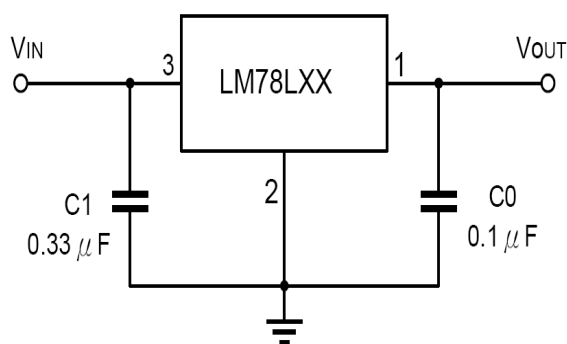


Fig.10- Dropout Voltage



Typical Application



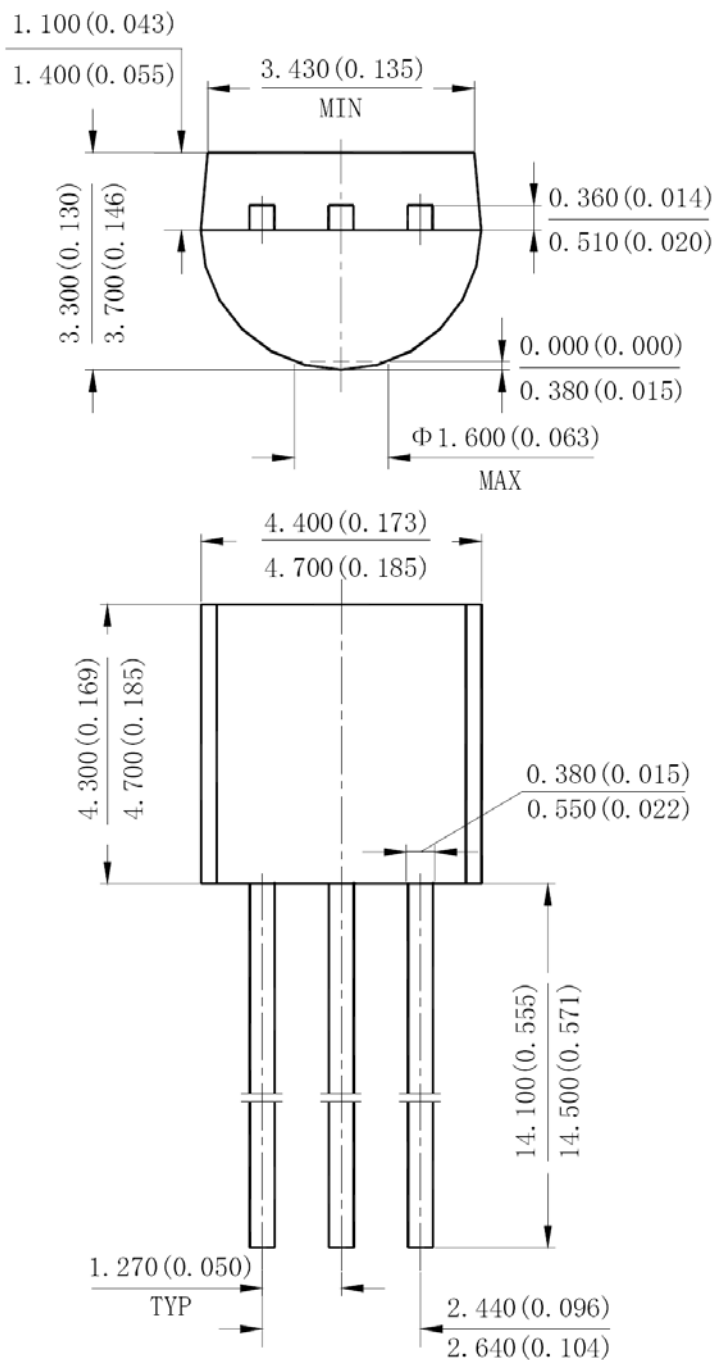
Note 1. To specify an output voltage, substitute voltage value for "XX".

2. Bypass capacitors are recommended for optimum stability and transient response and should be located as close as possible to the regulators.

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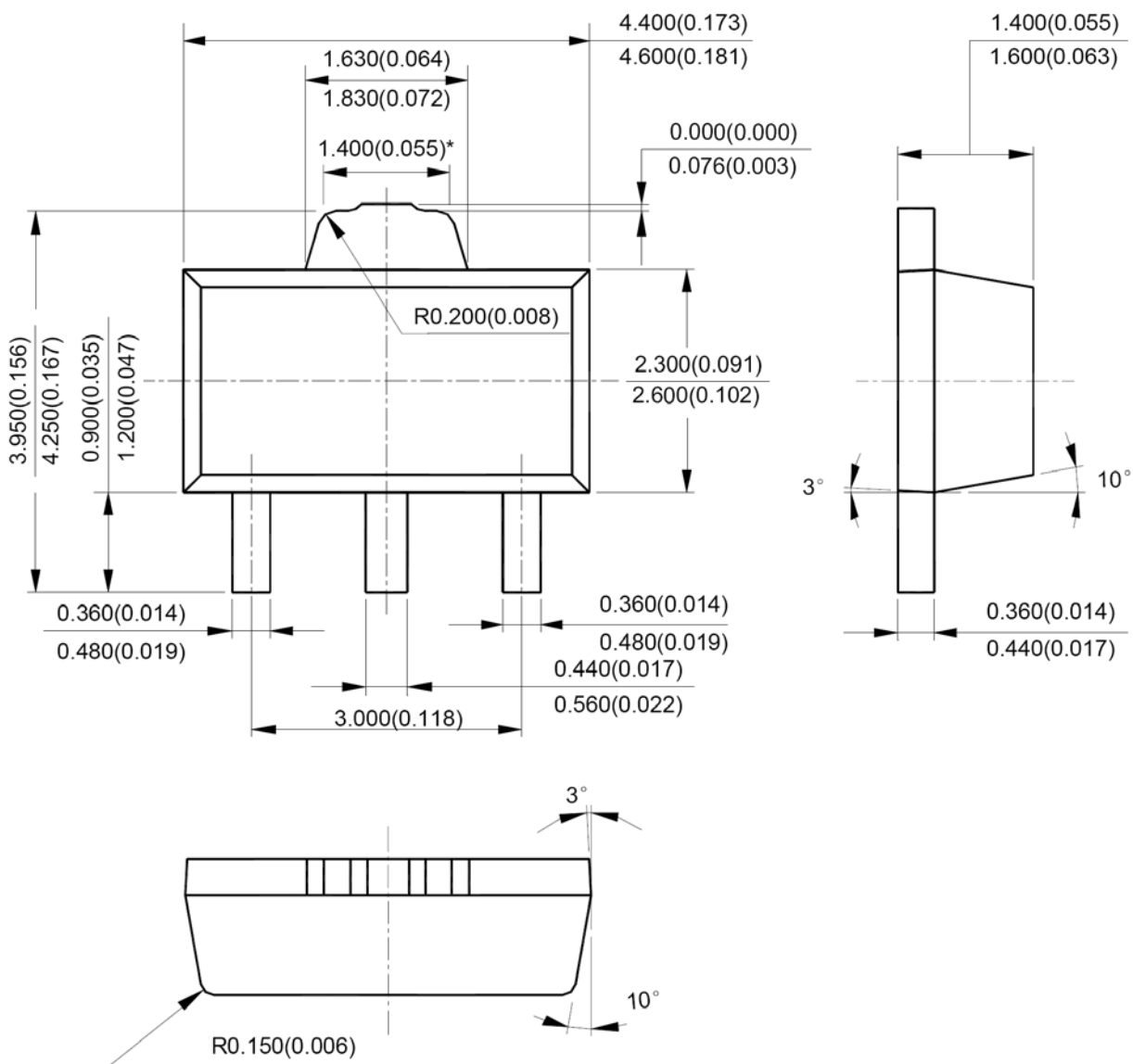
Dimensions in mm (inches)



TO-92

100mA Positive Voltage Regulator

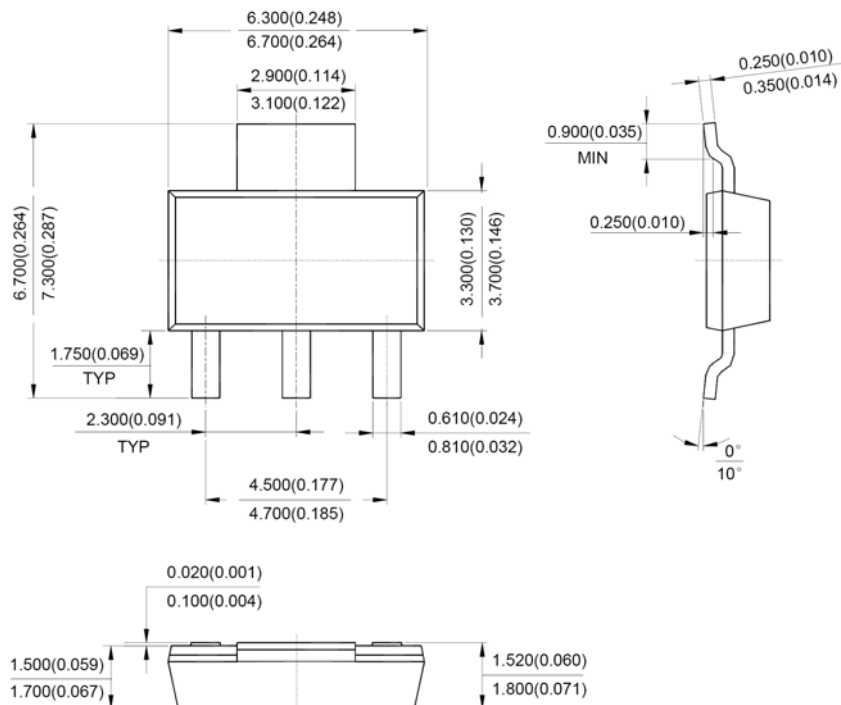
LM78L



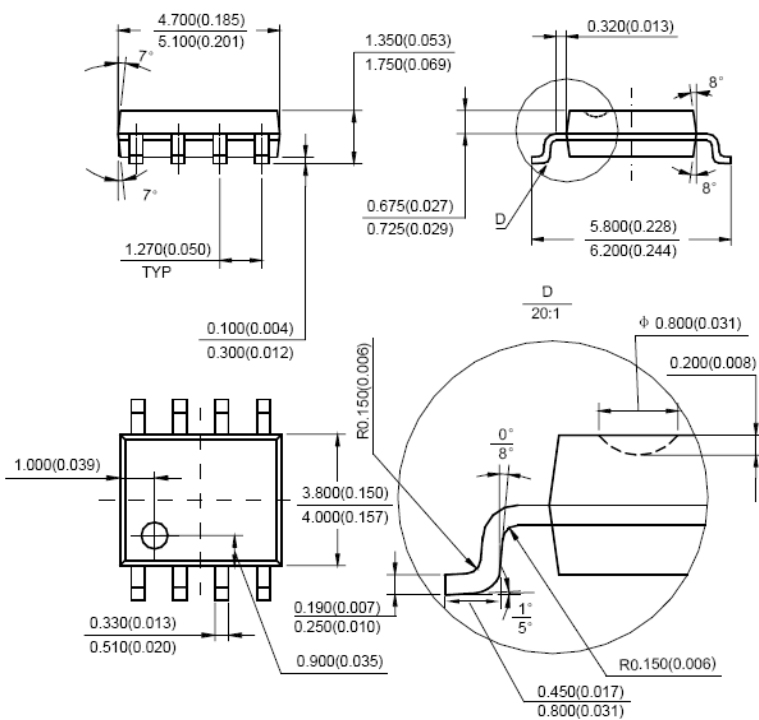
SOT-89

100mA Positive Voltage Regulator

LM78L



SOT-223



SOP-8



100mA Positive Voltage Regulator

LM78L

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