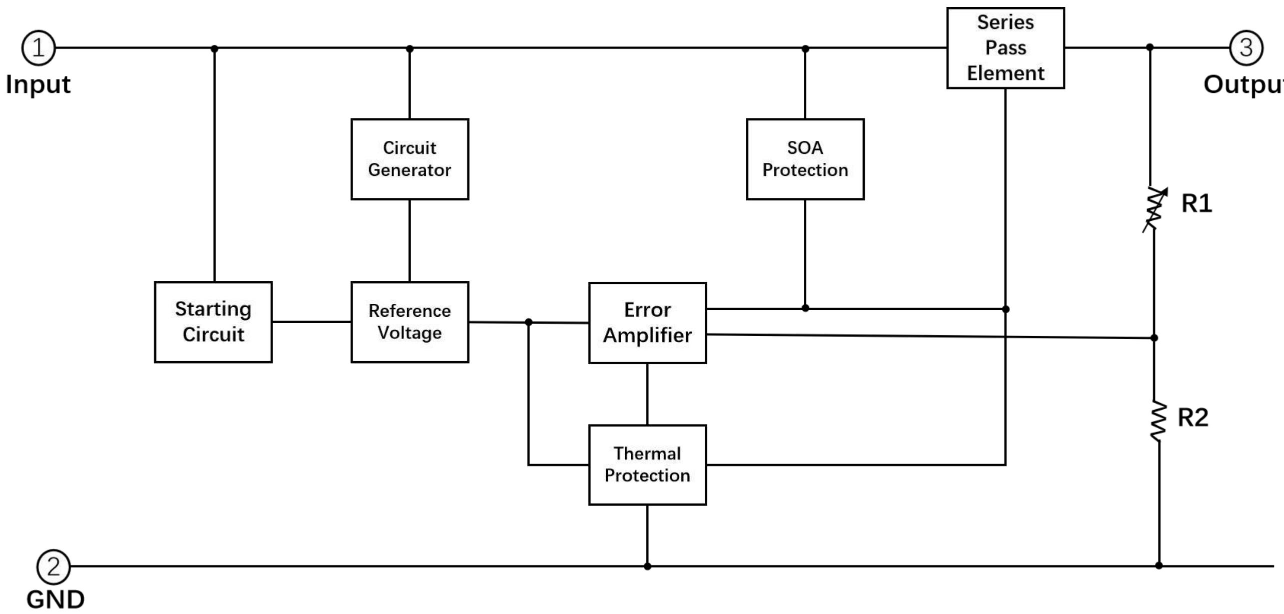
General Description

LTP78L series is three-terminal positive regulators.One of these regulators can deliver up to 150 mA of output current. The internal limiting and thermal-shutdown features of the regulator make them essentially immune to overload. When used as a replacement for a zener diode-resistor combination, an effective improvement in output impedance can be obtained, together with lower quiescent current.

Features and Benefits

- Output Current of 150mA
- Output Voltages of 3.3, 5, 6, 8, 9, 12, 15, 18, 20V
- Thermal Overload Protection
- Short Circuit Protection
- Output transistor safe operating area (SOA) protection
- No external components
- Package: SOT23, SOT89-3 and TO92

Functional Block Diagram



Ordering Information

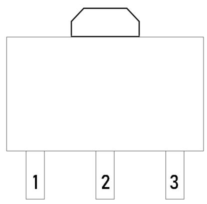
Model	Package Type	Ordering Number[1]	Package Quantity
LTP78Lxx	SOT23-3	LTP78LxxXT3	Tape and Reel, 3 000
	SOT89-3	LTP78LxxXT4	Tape and Reel, 1 000
	TO92	LTP78LxxZ92	Bulk, 50 000

Note:

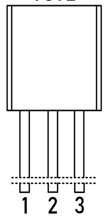
(1). xx stands for output voltage, e.g. if xx = 05, the output voltage is 5.0V; if xx = 12, the output voltage is 12V

Pin Configuration (Top View)

SOT89-3

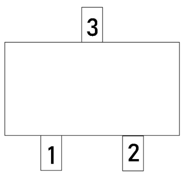


TO92



PIN Name	SOT89-3, TO92	Description
VOUT	1	Output Voltage pin
GND	2	GND pin
VIN	3	Input Voltage pin

SOT23-3



PIN Name	SOT23-3	Description
VOUT	1	Output Voltage pin
VIN	2	Input Voltage pin
GND	3	GND pin

Absolute Maximum Ratings (T_A=25℃)

Parameter		Rating	Unit
Input Supply Voltage: VIN MAX		30	V
Output Current: Iout MAX		150	mA
MAX Power: Pmax	SOT23	0.2	W
	SOT89	0.5	W
	TO92	0.5	W
Junction Temperature: T_J		-55~+150	℃
Operation Temperature: T_{OPR}		-40~+125	℃
Storage Temperature: T_{STR}		-55~+150	℃
Soldering Temperature and Time		+260 (Recommended 10s)	℃
ESD Rating (HBM)		5	kV

Note: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

Electrical Characteristics

LTP78L33 (Cin = 0.33 µF, C_O = 0.1 µF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 8.3 V	3.234	3.3	3.366	V
		I_O =1~40 mA, V_{IN} = 5.3~18 V	3.135	3.3	3.465	V
Line Regulation	LNR[(1)]	V_{IN} = 8.3 V~18 V, I_O = 20 mA	-20		20	mV
Load Regulation	LDR[(2)]	V_{IN} = 8.3 V, I_O = 1 mA~100 mA	-50		50	mV
		V_{IN} = 8.3 V, I_O = 1 mA~40 mA	-30		30	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 6.3 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		µV/V_O
Quiescent Current	I_Q	V_{IN} = 8.3 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 6.3 V~20 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 8.3 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L05 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 10 V	4.9	5.0	5.1	V
		I_O =1~40 mA, V_{IN} = 7 V~18 V	4.75	5.0	5.25	V
Line Regulation	LNR(1)	V_{IN} = 7 V~18 V, I_O = 20 mA	-20		20	mV
Load Regulation	LDR(2)	V_{IN} = 10 V, I_O = 1 mA~100 mA	-50		50	mV
		V_{IN} = 10 V, I_O = 1 mA~40 mA	-30		30	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 8 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 10 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 8 V~20 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 10 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L06 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 11 V	5.88	6.0	6.12	V
		I_O =1~40 mA, V_{IN} = 8 V~20 V	5.7	6.0	6.3	V
Line Regulation	LNR(1)	V_{IN} = 8 V~20 V, I_O = 20 mA	-30		30	mV
Load Regulation	LDR(2)	V_{IN} = 11 V, I_O = 1 mA~100 mA	-60		60	mV
		V_{IN} = 11 V, I_O = 1 mA~40 mA	-40		40	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 9 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 11 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	Δ I_Q	V_{IN} = 9 V~20 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 11 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L08 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 13 V	7.84	8.0	8.16	V
		I_O =1~40 mA, V_{IN} = 10 V~23 V	7.6	8.0	8.4	V
Line Regulation	LNR(1)	V_{IN} = 10 V~23 V, I_O = 20 mA	-40		40	mV
Load Regulation	LDR(2)	V_{IN} = 13 V, I_O = 1 mA~100 mA	-65		65	mV
		V_{IN} = 13 V, I_O = 1 mA~40 mA	-45		45	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 11 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 13 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 11 V~23 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 13 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L09 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 14 V	8.82	9.0	9.18	V
		I_O =1~40 mA, V_{IN} = 11 V~24 V	8.55	9.0	9.45	V
Line Regulation	LNR(1)	V_{IN} = 10 V~24 V, I_O = 20 mA	-40		40	mV
Load Regulation	LDR(2)	V_{IN} = 14 V, I_O = 1 mA~100 mA	-65		65	mV
		V_{IN} = 14 V, I_O = 1 mA~40 mA	-45		45	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 12 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 14 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 12 V~24 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 14 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L10 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 14 V	9.8	10.0	10.2	V
		I_O =1~40 mA, V_{IN} = 11 V~24 V	9.5	10.0	10.5	V
Line Regulation	LNR(1)	V_{IN} = 11 V~24 V, I_O = 20 mA	-40		40	mV
Load Regulation	LDR(2)	V_{IN} = 14 V, I_O = 1 mA~100 mA	-65		65	mV
		V_{IN} = 14 V, I_O = 1 mA~40 mA	-45		45	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 12 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 14 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 12 V~24 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 14 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L12 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 17 V	11.76	12.0	12.24	V
		I_O =1~40 mA, V_{IN} = 14 V~27 V	11.4	12.0	12.6	V
Line Regulation	LNR(1)	V_{IN} = 14 V~27 V, I_O = 20 mA	-50		50	mV
Load Regulation	LDR(2)	V_{IN} = 17 V, I_O = 1 mA~100 mA	-70		70	mV
		V_{IN} = 17 V, I_O = 1 mA~40 mA	-50		50	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 17 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 17 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 14 V~27 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 17 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L15 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 20 V	14.7	15.0	15.3	V
		I_O =1~40 mA, V_{IN} = 17 V~30 V	14.25	15.0	15.75	V
Line Regulation	LNR(1)	V_{IN} = 17 V~30 V, I_O = 20 mA	-50		50	mV
Load Regulation	LDR(2)	V_{IN} = 20 V, I_O = 1 mA~100 mA	-70		70	mV
		V_{IN} = 20 V, I_O = 1 mA~40 mA	-50		50	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 17 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 20 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 17 V~30 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 20 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Electrical Characteristics

LTP78L18 (Cin = 0.33 μF, C_O = 0.1 μF, T_A = 25 ℃, unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	V_{OUT}	I_O = 40 mA, V_{IN} = 23 V	17.64	18.0	18.36	V
		I_O =1~40 mA, V_{IN} = 20 V~28 V	17.1	18.0	18.9	V
Line Regulation	LNR(1)	V_{IN} = 20 V~28 V, I_O = 20 mA	-150		150	mV
Load Regulation	LDR(2)	V_{IN} = 23 V, I_O = 1 mA~100 mA	-170		170	mV
		V_{IN} = 23 V, I_O = 1 mA~40 mA	-150		150	mV
Dropout Voltage	V_{DO}	I_O = 100 mA		2		V
Ripple Rejection	PSRR	f = 120 Hz, I_O = 10 mA, V_{IN} = 23 V		70		dB
Output Noise Voltage	V_N	f = 10 Hz to 100 kHz		40		μV/V_O
Quiescent Current	I_Q	V_{IN} = 23 V, I_{OUT} = 40 mA		1.7		mA
Quiescent Current Change	ΔI_Q	V_{IN} = 20 V~28 V, I_O = 1 mA	-1.5		1.5	mA
		V_{IN} = 17 V, I_{OUT} = 1 mA~40 mA	-1		1	mA

Note:

(1) LNR: Line Regulation. The change in output voltage for a change in the input voltage. The measurement is made under conditions of low dissipation or by using pulse techniques such that the average chip temperature is not significantly affected.

(2) LDR: Load Regulation. The change in output voltage for a change in load current at constant chip temperature.

Typical Characteristics

LTP78L05 At T_A = 25℃, C_{IN} = 0.33 µF, C_O = 0.1 µF, unless otherwise noted.

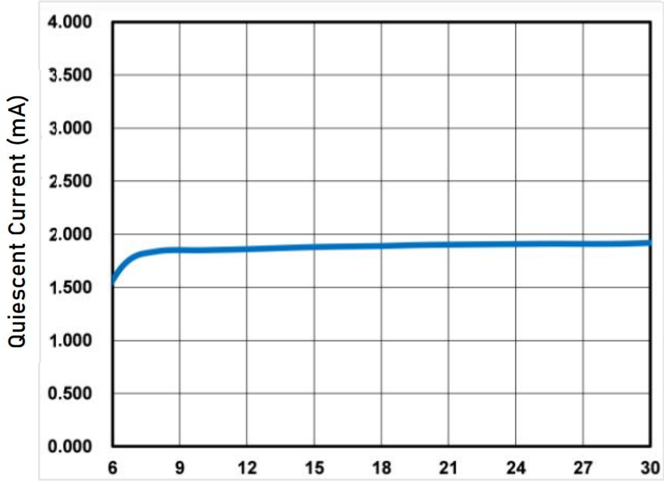


Figure 1. Quiescent Current vs. Input Voltage

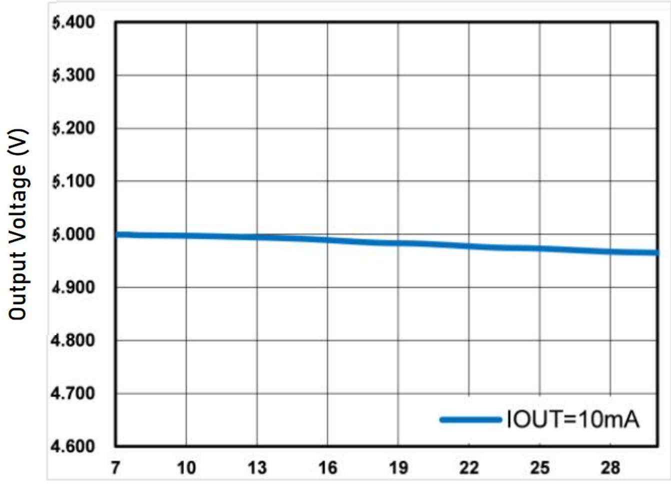


Figure 2. Output Voltage vs. Input Voltage

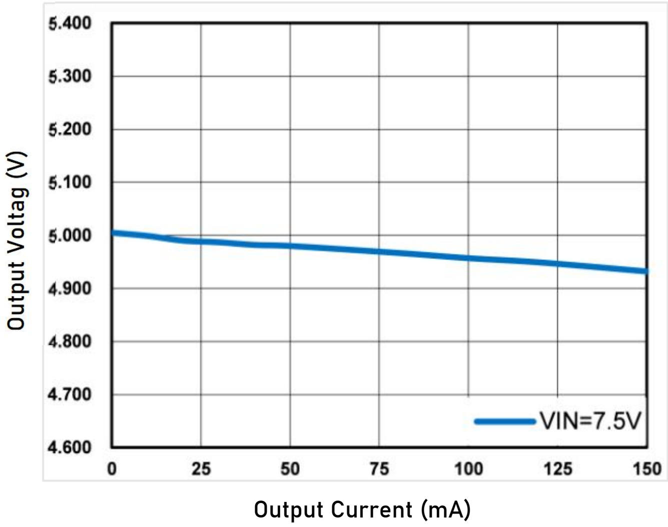


Figure 3. Output Voltage vs. Output Current

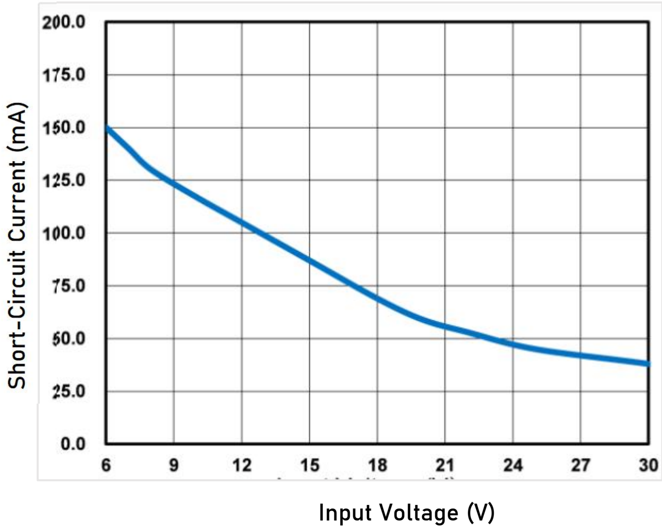


Figure 4. Short-Circuit Current vs. Input Voltage

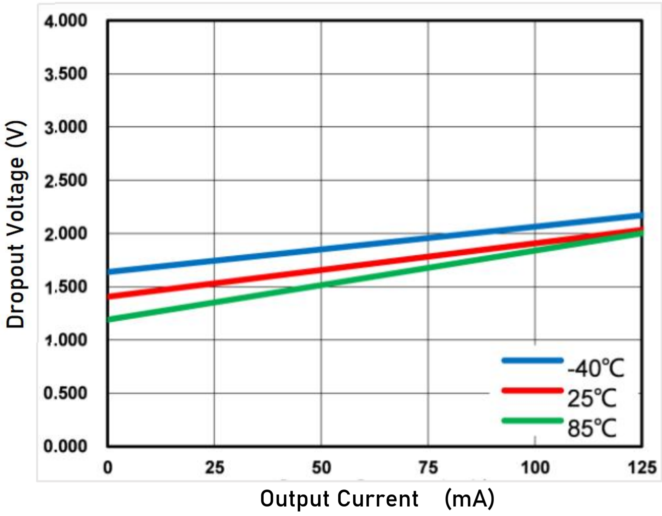


Figure 5. Dropout Voltage vs. Output Current

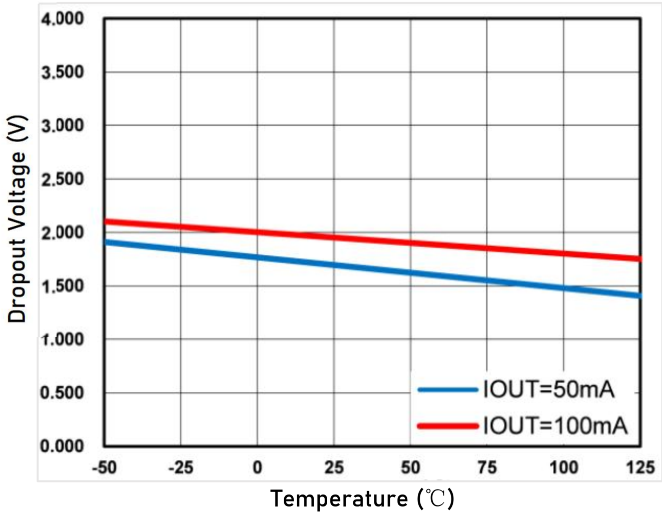


Figure 6. Dropout Voltage vs. Temperature

Typical Characteristics

LTP78L05 At T_A = 25℃, C_{IN} = 0.33 μF, C_O = 0.1 μF, unless otherwise noted.

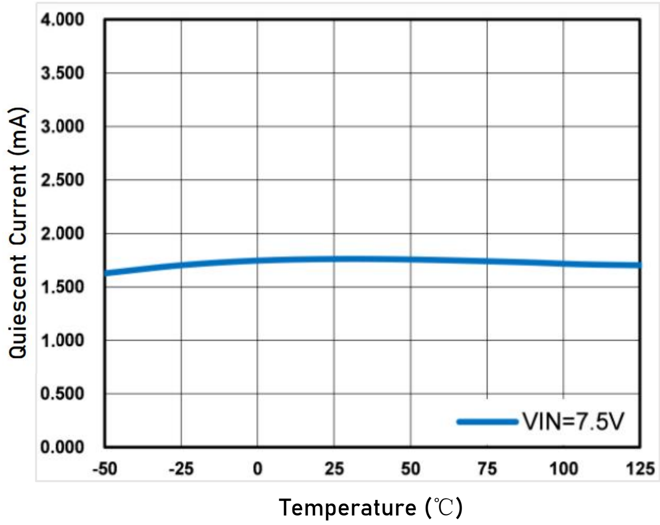


Figure 7. Quiescent Current vs. Temperature

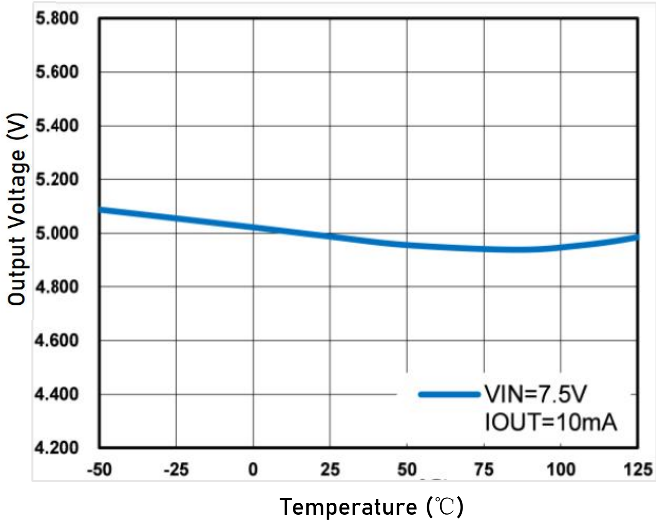


Figure 8. Output Voltage vs. Temperature

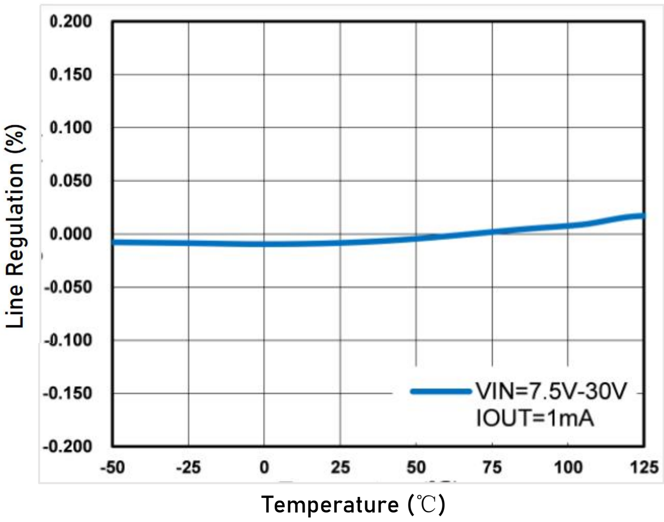


Figure 9. Line Regulation vs. Temperature

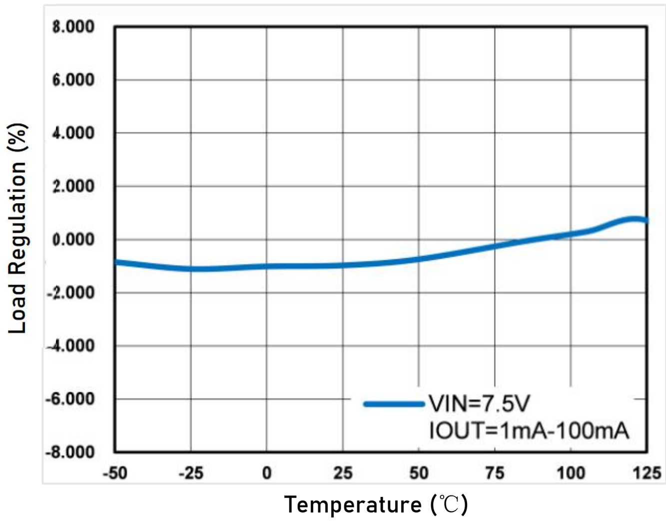


Figure 10. Load Regulation vs. Temperature

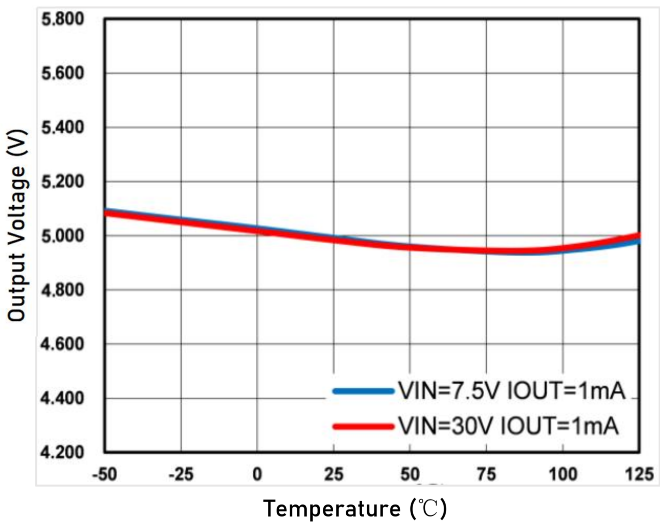


Figure 11. Output Voltage vs. Temperature

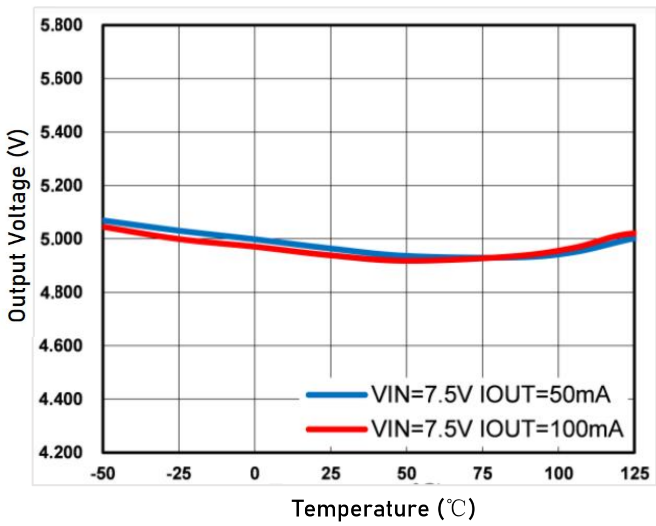


Figure 12. Output Voltage vs. Temperature

Typical Characteristics

LTP78L05 At T_A = 25℃, C_{IN} = 0.33 µF, C_O = 0.1 µF, unless otherwise noted.

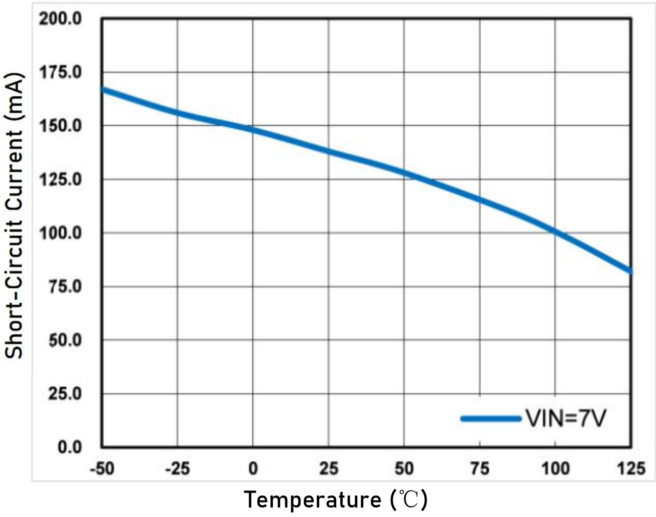


Figure 13. Short-Circuit Current vs. Temperature

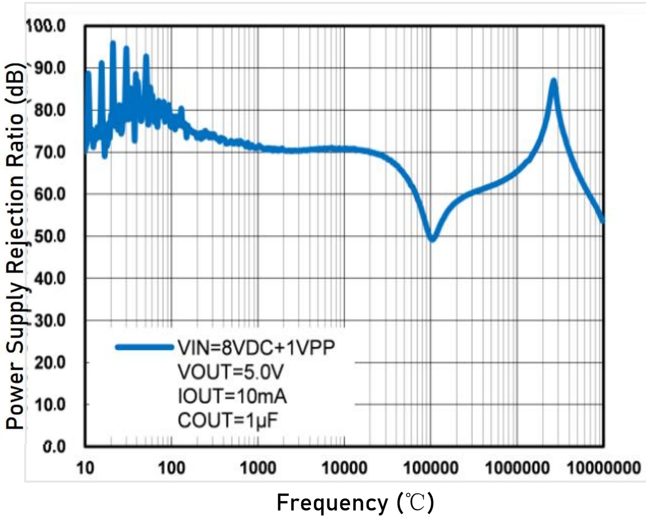


Figure 14. PSRR vs. Frequency

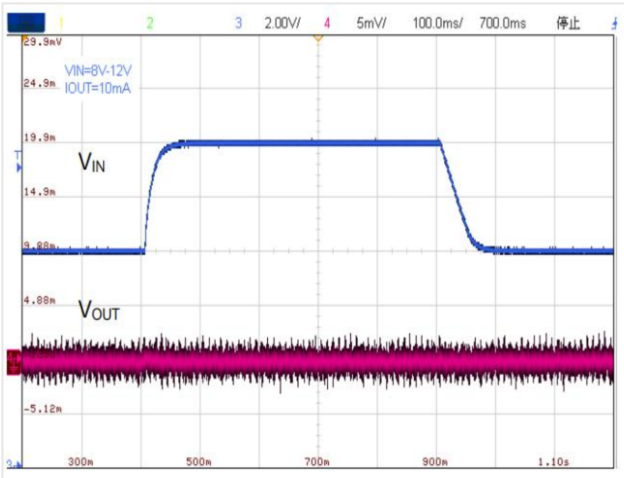


Figure 15. Input Transient Response (VIN = 8V ~ 12V)

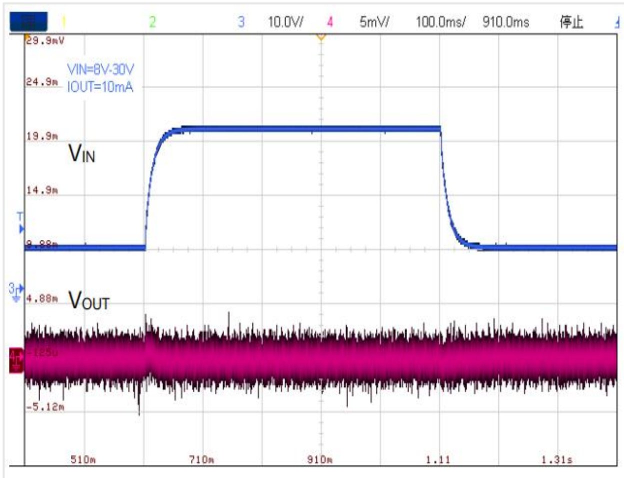


Figure 16. Input Transient Response (VIN = 8V ~ 30V)

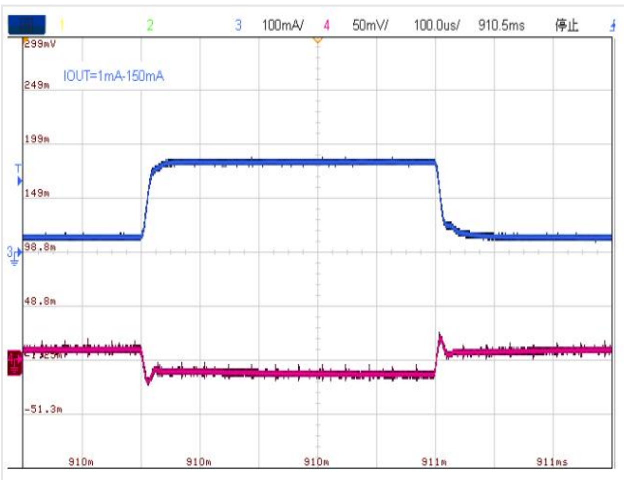


Figure 17. Load Transient Response (IOUT = 1mA ~ 150mA)

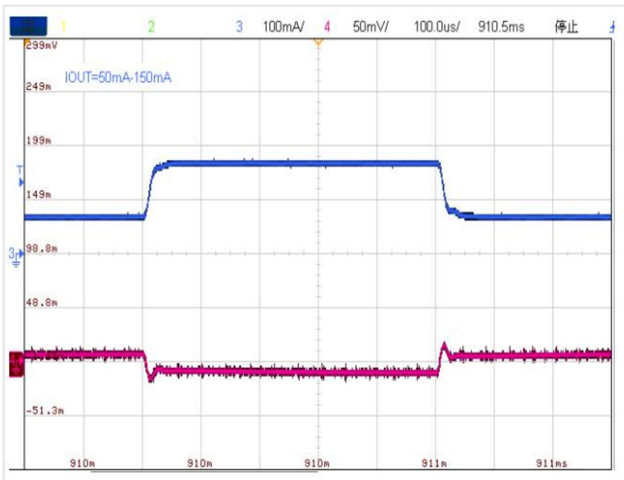


Figure 18. Load Transient Response (IOUT = 50mA ~ 150mA)

Typical Characteristics

LTP78L05 At T_A = 25℃, C_{IN} = 0.33 μF, C_O = 0.1 μF, unless otherwise noted.

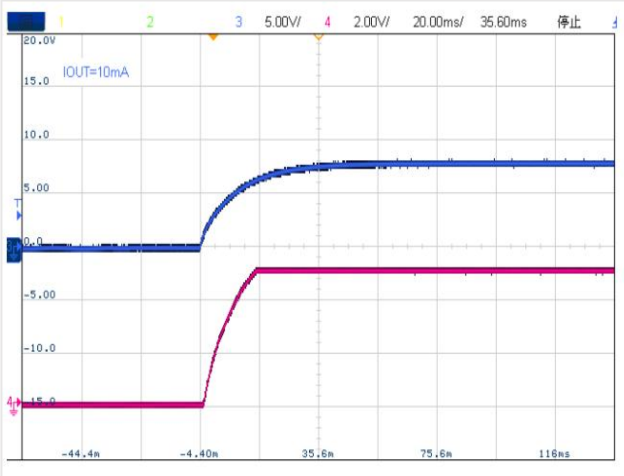


Figure 19. Power ON

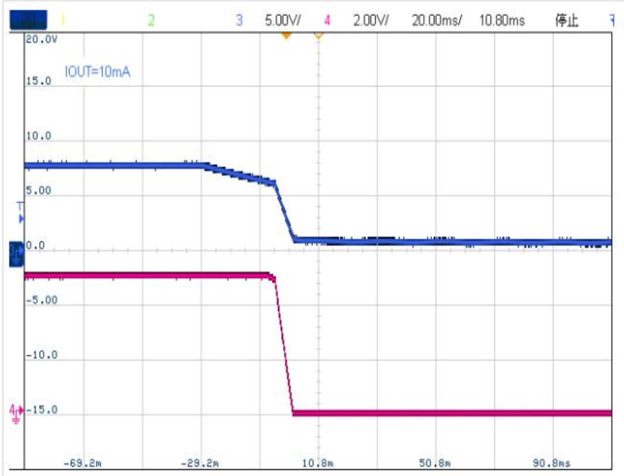


Figure 20. Power OFF

Operation Description

LTP78L series is designed with Thermal Overload Protection that shuts down the circuit when subjected to an excessive power overload condition, and Output Transistor Safe-Area Compensation that reduces the output short circuit current as the voltage across the pass transistor is increased. In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with a capacitor if the regulator is connected to the power supply filter with long wire lengths, or if the output load capacitance is large. An input bypass capacitor should be selected to provide good high frequency characteristics to insure stable operation under all load conditions. A 0.33µF or larger tantalum, mylaror other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with the shortest possible leads directly across the regulator's input terminals. Normally good construction techniques should be used to minimize ground loops and lead resistance drops since the regulator has no external sense lead.

Typical Application

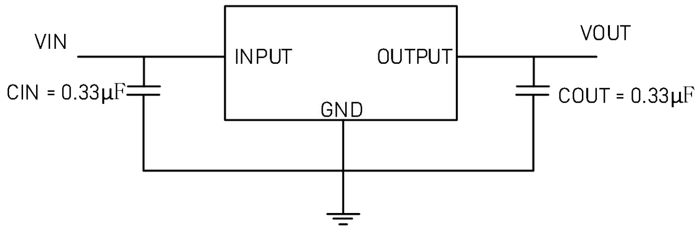
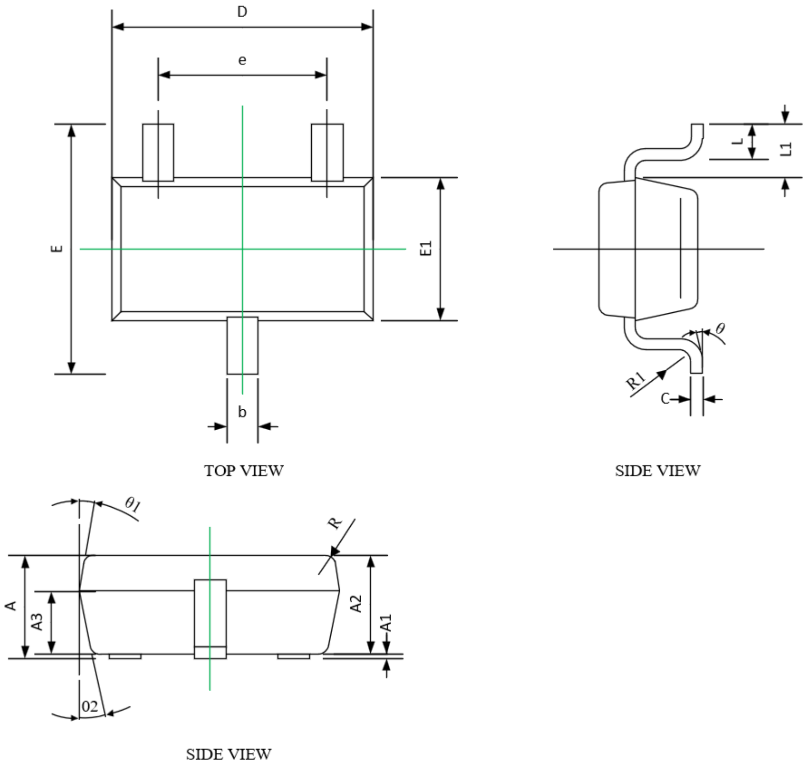


Fig 1: Typical Application

A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0 V above the output voltage even during the low point on the input ripple voltage. Cin is required if regulator is located an appreciable distance from power supply filter. Co is not needed for stability, however, it does improve transient response.

Package Outlines

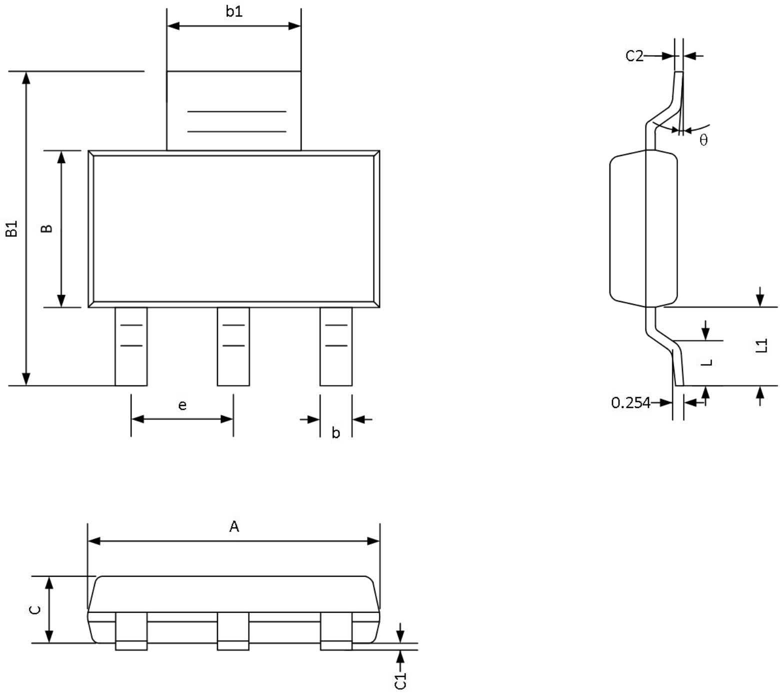
DIMENSIONS, SOT23-3



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	-	-	1.25
A1	0.02	-	0.10
A2	1.05	1.10	1.15
A3	0.65	0.70	0.75
b	0.30	0.35	0.45
c	0.127 BSC		
D	2.87	2.92	2.97
E	2.72	2.80	2.88
E1	1.55	1.60	1.65
e	1.85	1.90	1.95
L	0.32	0.40	0.48
L1	0.55	0.60	0.65
R	0.10 REF		
R1	0.12 REF		
θ	0	-	8°
θ1	8°	10°	12°
θ2	10°	12°	14°

Package Outlines (Cont.)

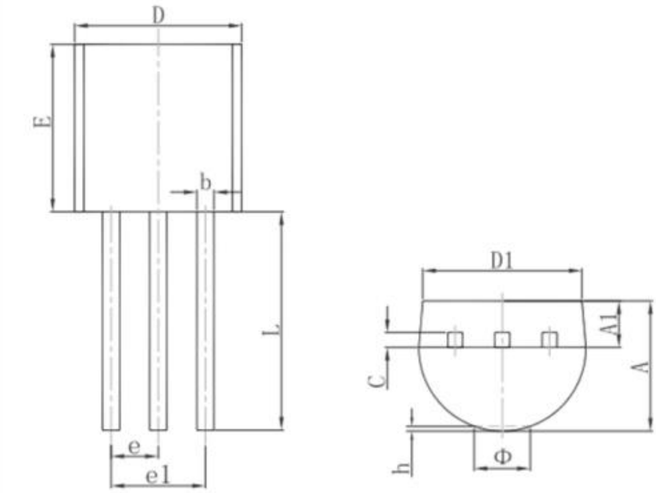
DIMENSIONS, SOT89-3



Symbol \ Dimension	Min（mm）	Max（mm）
A	6.40	6.60
e	2.286（BSC）	
b	0.66	0.76
b1	2.95	3.05
B	3.40	3.60
B1	6.85	7.15
C	1.45	1.65
C1	0.03	0.15
C2	0.20	0.35
L	0.76	1.16
L1	1.70	1.80
θ	0°	8°

Package Outlines (Cont.)

DIMENSIONS, TO92



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.300	4.700	0.169	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP.		0.050 TYP.	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015

Important Notice

Linearin is a global fabless semiconductor company specializing in advanced high-performance high-quality analog / mixed-signal IC products and sensor solutions. The company is devoted to the innovation of high performance, analog -intensive sensor front-end products and modular sensor solutions, applied in multi-market of medical & wearable devices, smart home, sensing of IoT, intelligent industrial & smart factory (industry 4.0), and automotives. Linearin's product families include widely-used standard catalog products, solution-based application specific standard products (ASSPs) and sensor modules that help customers achieve faster time-to-market products. Go to http://www.linearin.com for a complete list of Linearin product families.

For additional product information, or full datasheet, please contact with the Linearin's Sales Department or Representatives.