3-Terminal 150mA Positive Voltage Regulator

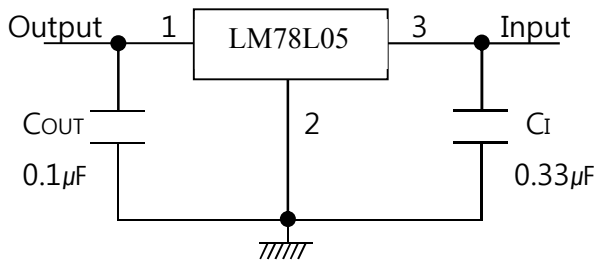
DESCRIPTION

LM78LXX a series of positive voltage regulators are inexpensive, easy-to-use devices suitable for a multitude of applications that require a regulated supply of up to 150 mA. These devices offer a substantial performance advantage over the traditional Zener Diode–Resistor combination, as output impedance and quiescent current are substantially reduced.

FEATURES

- **Low Cost**
- **No external components required**
- **Output voltages (5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 24V)**
- **Internal Thermal shutdown and SOA protection**
- **Output voltage offered in 4% Tolerance**
- **Pb-Free Packages are available**
- **High ESD Level (HBM>5,000V, MM>500V)**

Standard Application



The input voltage must remain typically 2.0V above the output voltage even during the Low point on the ripple voltage.

- CI is required if regulator is located an appreciable distance from power filter.
- Co improves transient response. Value of ≤0.1μF could cause instability.

Package Information

SOT-89

PIN INFO. 1. OUTPUT 2. GND 3. INPUT

Tab (Heat sink) is GND

Ordering Information

Part No	Package	Packing	Finish	Halogen	Packing Unit	Remark
LM78LXXQTRL	SOT-89	Reel & Tape	Sn	Free	10,000	*XX : Output Voltage Option

XX : Output Voltage Option
05=5V, 06=6V, 08=8V, 09=9V, 10=10V, 15=15V, 18=18V, 24=24V

Maximum Ratings

Rating	Symbol	Value			Unit
		SOP-8	TO-92	SOT-89	
Input Voltage 5V~18V	V_I	35			V
Input Voltage 24V	V_I	40			V
Power Dissipation	P_D	Internally Limited			W
Thermal Resistance of Junction to Ambient	$R_{\theta JA}$		200		°C/W
Thermal Resistance of Junction to Case	$R_{\theta JC}$	†		15	°C/W
Storage Temperature	T_{STG}	-55~150			°C
Operating Junction Temperature	T_J	150			°C
Operating Temperature	T_{OPR}	-40~125			°C

† Mount on a glass epoxy circuit board of 25.4 mm x 25.4 mm PAD dimension of 50 mm^2

Stresses exceeding Maximum ratings may damage the device. Maximum ratings are stress ratings. Functional operation above the recommended operating conditions is not implied. Extended exposure to stresses the above the recommended operating conditions may affect device reliability.

Electrical Characteristics LM78L05

(T_J = 0 to 125 °C, V_{IN}=10.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	4.8	5.0	5.2	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	4.75	5.0	5.25	
Line regulation (T_J=25°C) (**Note 1)**	LIR	7.0V ≤ V_{IN} ≤ 20.0V		8.0	150	mV
		8.0V ≤ V_{IN} ≤ 20.0V		6.0	100	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		11	60	mV
		1.0 mA ≤ I_O ≤ 40 mA		5.0	30	
Quiescent current	I_Q	T_J=25°C		2.0	5.5	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		8.0V ≤ V_{IN} ≤ 20.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		-0.65		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		40		µV/V_O
Ripple rejection	RR	8.0V ≤ V_{IN} ≤ 18.0V, f=120 Hz T_J=25°C	41	80		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used.

Electrical Characteristics LM78L06

(T_J = 0 to 125 °C, V_{IN}=12.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	5.76	6.0	6.24	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	5.7	6.0	6.3	
Line regulation (T_J=25°C) (**Note 1)**	LIR	8.5V ≤ V_{IN} ≤ 20.0V		64	175	mV
		9.0V ≤ V_{IN} ≤ 20.0V		54	110	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		12.8	70	mV
		1.0 mA ≤ I_O ≤ 40 mA		5.8	35	
Quiescent current	I_Q	T_J=25°C			5.5	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		9.0V ≤ V_{IN} ≤ 20.0V			1.5	
Output Voltage Drift	ΔV$_O$/ ΔT	I_O = 5 mA		0.75		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		40		µV/V$_O$
Ripple rejection	RR	10.0V ≤ V_{IN} ≤ 20.0V, f=120 Hz T_J=25°C	40	46		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used.

Electrical Characteristics LM78L08

(T_J = 0 to 125 °C, V_{IN}=14.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	7.7	8.0	8.3	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	7.6	8.0	8.4	
Line regulation (T_J=25°C) (**Note 1)**	LIR	10.5V ≤ V_{IN} ≤ 23.0V		10	175	mV
		11.0V ≤ V_{IN} ≤ 23.0V		8.0	125	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		15	80	mV
		1.0 mA ≤ I_O ≤ 40 mA		8.0	40	
Quiescent current	I_Q	T_J=25°C		2.0	5.5	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		11.0V ≤ V_{IN} ≤ 23.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		-0.8		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		60		µV/V_O
Ripple rejection	RR	11.0V ≤ V_{IN} ≤ 21.0V, f=120 Hz T_J=25°C	39	70		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used.

Electrical Characteristics LM78L09

(T_J = 0 to 125 °C, V_{IN}=15.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	8.64	9.0	9.36	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	8.55	9.0	9.45	
Line regulation (T_J=25°C) (**Note 1)**	LIR	11.4V ≤ V_{IN} ≤ 24.0V		90	200	mV
		12V ≤ V_{IN} ≤ 24.0V		100	150	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		20	90	mV
		1.0 mA ≤ I_O ≤ 40 mA		10	45	
Quiescent current	I_Q	T_J=25°C		2.1	6.0	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		11.5V ≤ V_{IN} ≤ 24.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		-0.9		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		70		µV/V_O
Ripple rejection	RR	12.0V ≤ V_{IN} ≤ 22.0V, f=120 Hz T_J=25°C	38	44		dB
Dropout voltage	V_{DROP}	T_J=25°C		2.0		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used

Electrical Characteristics LM78L10

(T_J = 0 to 125 °C, V_{IN}=16.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	9.6	10.0	10.4	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	9.5	10.0	10.5	
Line regulation (T_J=25°C) (**Note 1)**	LIR	12.5V ≤ V_{IN} ≤ 25.0V		100	220	mV
		13.0V ≤ V_{IN} ≤ 25.0V		100	170	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		20	94	mV
		1.0 mA ≤ I_O ≤ 40 mA		10	47	
Quiescent current	I_Q	T_J=25°C			6.0	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		12.5V ≤ V_{IN} ≤ 25.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		0.95		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		74		µV/V_O
Ripple rejection	RR	15.0V ≤ V_{IN} ≤ 25.0V, f=120 Hz T_J=25°C	38	43		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used

Electrical Characteristics LM78L12

(T_J = 0 to 125 °C, V_{IN}=19.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	11.5	12.0	12.5	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	11.4	12.0	12.6	
Line regulation (T_J=25°C) (**Note 1)**	LIR	14.5V ≤ V_{IN} ≤ 27.0V		120	250	mV
		16.0V ≤ V_{IN} ≤ 27.0V		100	200	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		20	100	mV
		1.0 mA ≤ I_O ≤ 40 mA		10	50	
Quiescent current	I_Q	T_J=25°C		3.2	6.5	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		16.0V ≤ V_{IN} ≤ 27.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		-1.0		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		80		µV/V_O
Ripple rejection	RR	15.0V ≤ V_{IN} ≤ 25.0V, f=120 Hz T_J=25°C	36	41		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used

Electrical Characteristics LM78L15

(T_J = 0 to 125 °C, V_{IN}=23.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	14.4	15.0	15.6	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	14.2	15.0	15.7	
Line regulation (T_J=25°C) (**Note 1)**	LIR	17.5V ≤ V_{IN} ≤ 30.0V		130	300	mV
		20.0V ≤ V_{IN} ≤ 30.0V		110	250	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		25	150	mV
		1.0 mA ≤ I_O ≤ 40 mA		12	75	
Quiescent current	I_Q	T_J=25°C		3.3	6.5	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		20.0V ≤ V_{IN} ≤30.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		-1.3		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		90		µV/V_O
Ripple rejection	RR	18.5V ≤ V_{IN} ≤ 28.5V, f=120 Hz T_J=25°C	34	40		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used

Electrical Characteristics LM78L18

(T_J = 0 to 125 °C, V_{IN}=27.0V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	17.3	18.0	18.7	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	17.1	18.0	18.9	
Line regulation (T_J=25°C) (**Note 1)**	LIR	21.0V ≤ V_{IN} ≤ 33.0V		32	325	mV
		22.0V ≤ V_{IN} ≤ 33.0V		27	275	
Load regulation (T_J=25°C) (**Note 1)**	LOR	1.0 mA ≤ I_O ≤ 100 mA		30	170	mV
		1.0 mA ≤ I_O ≤ 40 mA		15	75	
Quiescent current	I_Q	T_J=25°C		3.3	6.5	mA
Quiescent current change	Δ I_Q	1.0 mA ≤ I_O ≤ 40 mA			0.1	mA
		21.0V ≤ V_{IN} ≤ 33.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		-1.5		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		150		µV/V_O
Ripple rejection	RR	23.0V ≤ V_{IN} ≤ 33.0V, f=120 Hz T_J=25°C	32	38		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used

Electrical Characteristics LM78L24

(T_J = 0 to 125 °C, V_{IN}=33V, I_O=40 mA, C_I=0.33 µF, C_O=0.1 µF, unless otherwise noted)

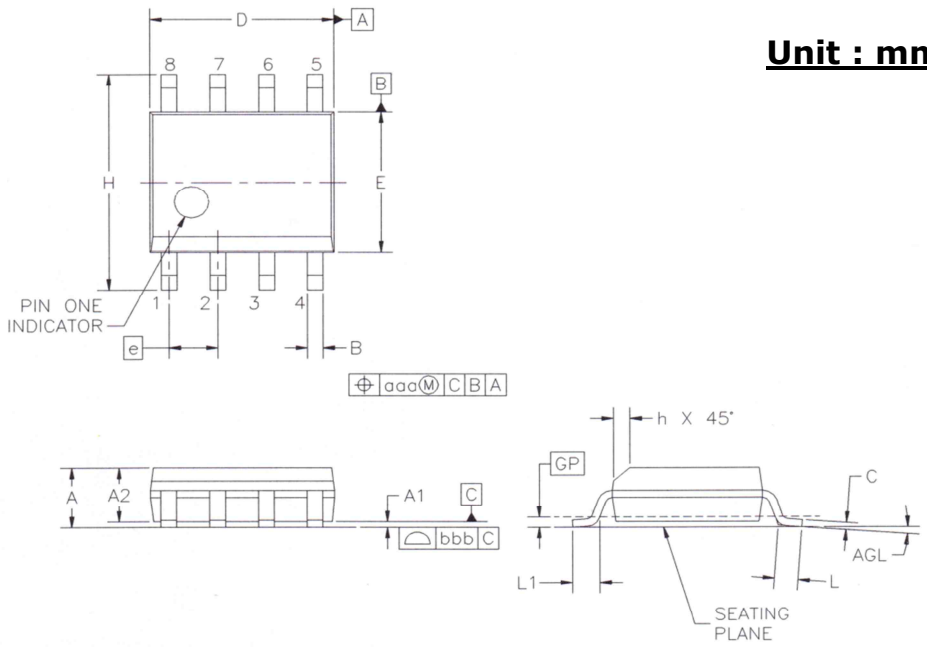
Characteristic	Symbol	Condition	Min	Typ	Max	Unit
Output voltage	V_O	T_J=25°C	23.0	24.0	25.0	V
		1mA ≤ I_O ≤ 70 mA , P_D≤0.75W	22.8	24.0	25.2	
Line regulation (T_J=25°C) (**Note 1)**	LIR	27.0V ≤ V_{IN} ≤ 38.0V		35	350	mV
		28.0V ≤ V_{IN} ≤ 38.0V		30	300	
Load regulation (T_J=25°C) (**Note 1)**	LOR	5.0 mA ≤ I_O ≤ 1.5A		40	200	mV
		250 mA ≤ I_O ≤ 750 mA		20	100	
Quiescent current	I_Q	T_J=25°C		3.5	6.5	mA
Quiescent current change	Δ I_Q	5.0 mA ≤ I_O ≤ 1.0 A			0.1	mA
		28.0V ≤ V_{IN} ≤ 38.0V			1.5	
Output Voltage Drift	ΔV_O/ ΔT	I_O = 5 mA		-2.0		mV/°C
Output noise voltage	V_N	10 Hz ≤f ≤ 100 KHz, T_A=25°		200		µV/V_O
Ripple rejection	RR	28.0V ≤ V_{IN} ≤ 38.0V, f=120 Hz T_J=25°C	31	35		dB
Dropout voltage	V_{DROP}	T_J=25°C		1.7		V
Short circuit current limit	I_{SC}	V_{IN} = 35V, T_A=25°C		230		mA
Peak output current	I_{PK}	T_J=25°C		0.55		A

Note 1 Line and Load regulation are specified at constant junction temperature. Changes of V_O due to heating effects must be taken into account separately. Pulse testing with low duty circle is used

Package Dimension

SOP-8

Unit : mm

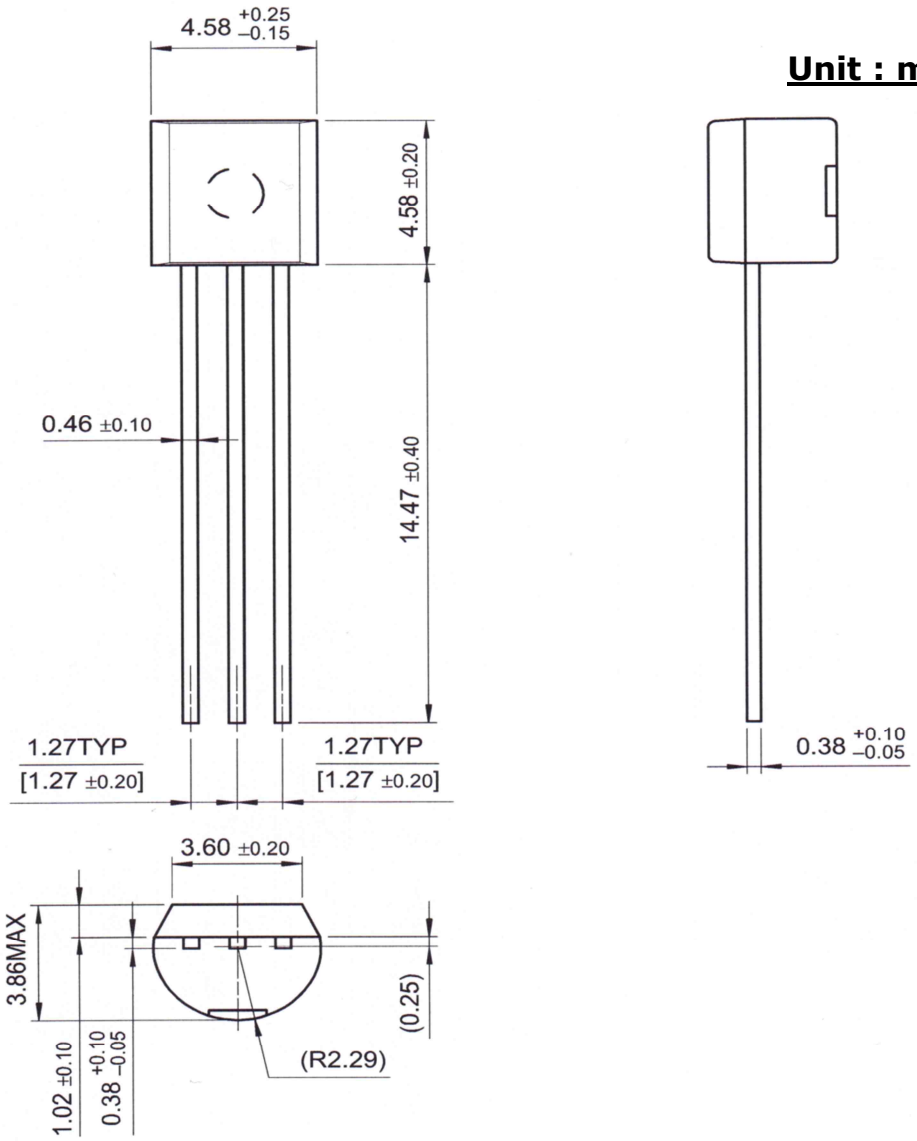


Symbol	Min	Nom	Max
A	-	-	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.50
B	0.35	0.37	0.51
C	0.19	0.20	0.25
D	4.80	4.90	5.00
E	3.80	3.90	4.00
e	1.27BSC		
H	5.79	5.99	6.20
h	0.25	-	0.50
L	0.50	0.70	0.90
GP	0.36 BSC		
q	0	-	8
aaa	-	-	0.25
bbb	-	-	0.10

Package Dimension

TO-92

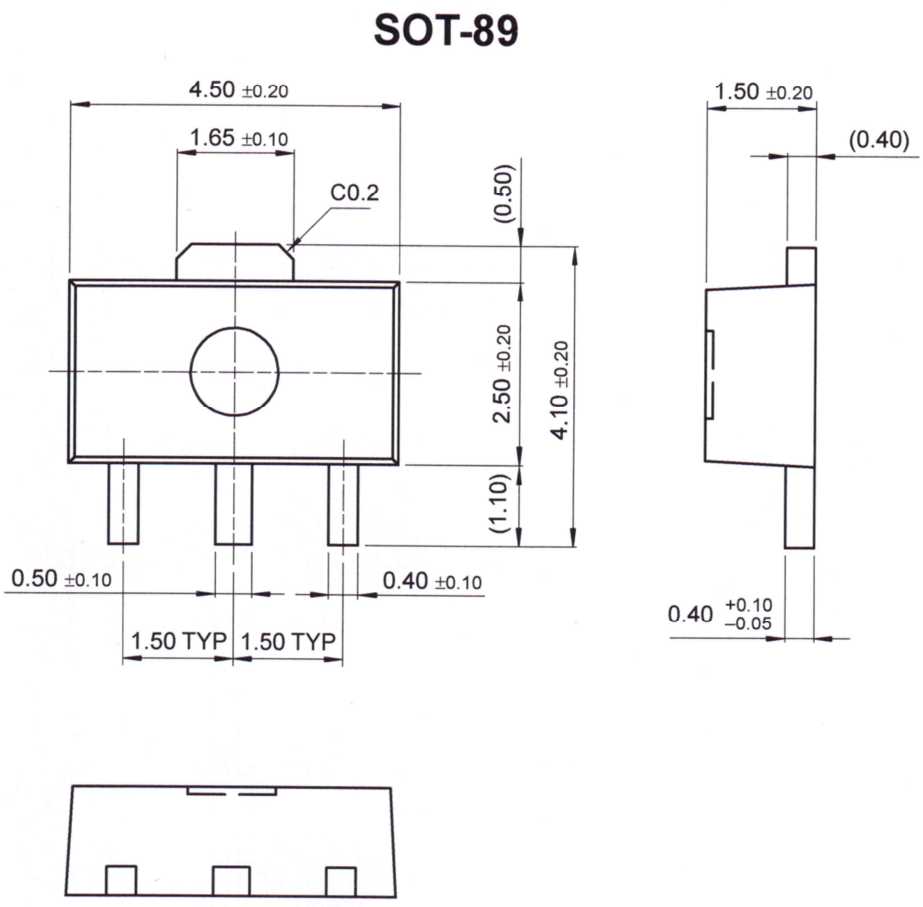
Unit : mm



Package Dimension

SOT-89

Unit : mm



Revision History

No	Date	Contents
1	2015-01-30	Initial Brief Datasheet Release
2	2015-06-22	ESD Level Update

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