

1.0A, Adjustable Three-Terminal Positive Voltage Regulator

• Features

- Output Voltage Range: from 1.3V to 37V
- Output Current: 1.0A
- Line Regulation: 0.01%/V (Typ.)
- Load Regulation: 0.1% (Typ.)
- Internal Short-Circuit Current Limiting
- Thermal Overload Protection
- PSRR: 80dB at 120Hz for $C_{ADJ} = 10\mu F$
- Output Safe-Area Compensation

• Applications

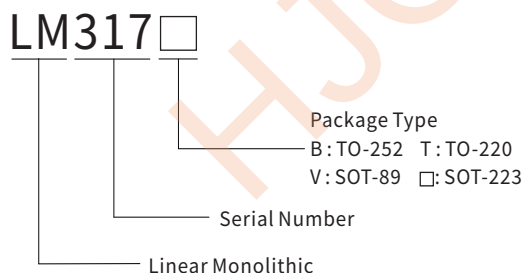
- Multifunction printers
- AC drive power stage modules
- Electricity meters
- Servo drive control modules
- Merchant network and server PSU

• General Description

The LM317 is an adjustable three-pin, positive-voltage regulator capable of supplying more than 1A over an output voltage range of 1.3V to 37V. The device requires only two external resistors to set the output voltage. The device features a typical line regulation of 0.01% and typical load regulation of 0.1%. The LM317 includes current limiting, thermal overload protection, and safe operating area protection. Overload protection remains functional even if the ADJUST pin is disconnected.

Typically, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors. In that case, an input bypass is needed. Add an optional output capacitor to improve transient response. Bypass the adjustment pin to achieve very high ripple rejection ratios that are difficult to achieve with standard 3-pin regulators.

• Part Numbering



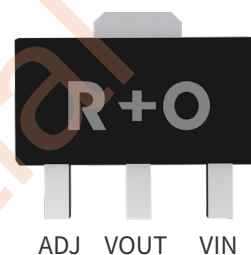
Supply Voltage

$$V_{IN} - V_{OUT} = 40V(\text{Max.})$$

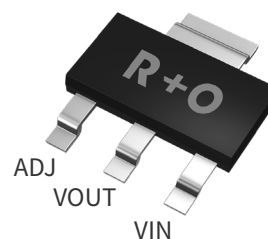
Output Current

1.0A (Max.)

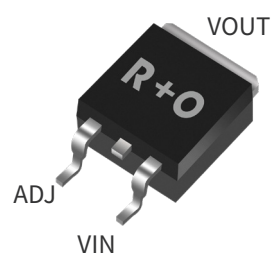
SOT-89



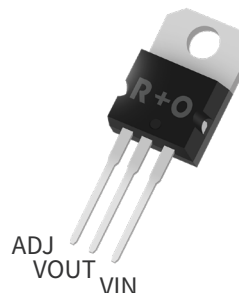
SOT-223



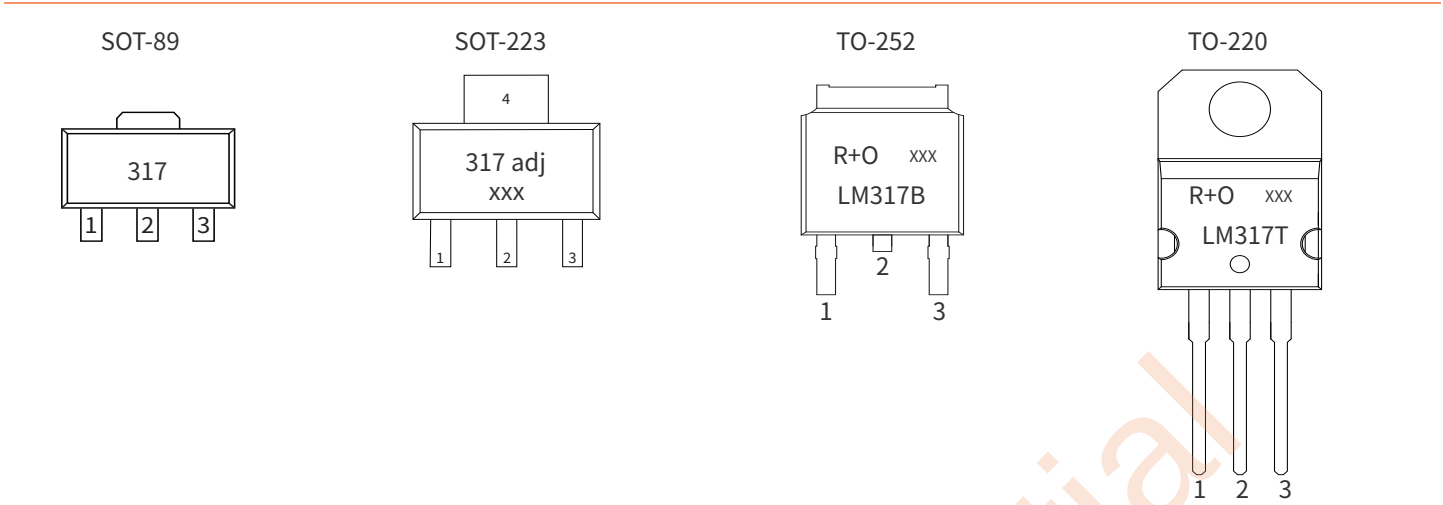
TO-252



TO-220



● Pin Configuration & Marking



● Pin Description

Pin Number	Pin Name	Description
1	ADJUST	Output voltage adjustment pin. Connect to a resistor divider to set V_{OUT} .
2	OUTPUT	Output voltage pin for the regulator.
3	INPUT	Input voltage pin for the regulator.

The regulator is floating and detects only the input-to-output differential voltage. Thus, supplies of several hundred volts are regulated as long as the maximum input-to-output differential is not exceeded. That is, avoid short-circuiting the output.

By connecting a fixed resistor between the adjustment pin and output, the LM317 is also able to be used as a precision current regulator. Supplies with electronic shutdown are achieved by clamping the adjustment terminal to ground, which programs the output to 1.3V where most loads draw little current.

● Ordering Information

Order Number	Package	Package Code	Unit Weight(g)	Tube/Reel(pcs)	Box(pcs)	Carton(pcs)	Delivery Mode	MSL
LM317	SOT-223	R3	0.305	2500/Reel	5000	40000	13"	3
LM317V	SOT-89	R1	0.045	1000/Reel	10000	40000	7"	3
LM317T	TO-220	/	2.04	50/Tube	1000	10000	/	/
LM317B	TO-252	R3	0.463	2500/Reel	5000	40000	13"	3

● Functional Block Diagram

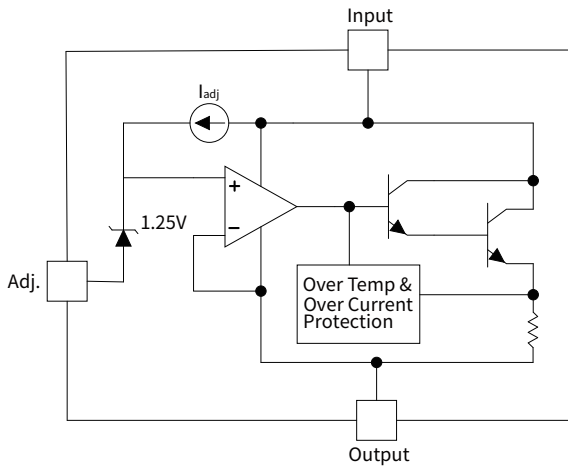


Figure 1.Internal Block Diagram

● Absolute Maximum Ratings (T_A=25°C Unless otherwise specified)

Parameter	Symbol	Ratings	Unit
Input - Output Voltage Difference	V _{IN} - V _{OUT}	40	V
Power Dissipation	P _D	Internal Limited	W
Junction Temperature	T _J	+150	°C
Operating Temperature	T _{OPR}	-40 to +125	°C
Storage Temperature Range	T _{stg}	-65 to +150	°C

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

● Thermal Information(T_A=25°C Unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Junction to Ambient	SOT-89	θ_{JA}	44	°C /W
	SOT-223		165	
	TO-220		65	
	TO-252		112	
Junction to Case	SOT-89	θ_{JC}	86.9	°C /W
	SOT-223		23	
	TO-220		5	
	TO-252		12	

● Recommended Operating Conditions

Parameter Name	Symbol	Value	Unit
Supply Voltage	$V_{IN} - V_{OUT}$	3 to 40	V
Operating Junction Temperature Range	T_{OPR}	0 to +125	°C

● Electrical Characteristics ($V_{IN} - V_{OUT} = 5V$, $I_{OUT} = 10mA$, $T_A = 25C$, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Reference Voltage	V_{REF}	$3V \leq V_{IN} - V_{OUT} \leq 40V$, $10mA \leq I_{OUT} \leq 1A$, $P_D \leq 20W$	1.20	1.25	1.30	V
Line Regulation	ΔV_{LINE}	$3V \leq V_{IN} - V_{OUT} \leq 40V$, $I_{OUT} = 10mA$	--	0.01	0.04	%/V
Load Regulation	ΔV_{LOAD}	$10mA \leq I_{OUT} \leq 1A$	$V_{OUT} \leq 5V$	--	5	mV
			$V_{OUT} \geq 5V$	--	0.1	%
Adjustable Pin Current	I_{ADJ}	Over Full Operating Temperature Range	--	50	100	μA
Adjustable Pin Current Change	ΔI_{ADJ}	$3V \leq V_{IN} - V_{OUT} \leq 40V$, $10mA \leq I_{OUT} \leq 1A$, $P_D \leq 20W$	--	0.2	5	μA
Power Supply Rejection Rate	PSRR	$V_{OUT} = 10V$, $f = 120Hz$	$C_{ADJ} = 0$	--	65	dB
			$C_{ADJ} = 10\mu F$	66	80	
Output Voltage Temperature Coefficient	TC_{VOUT}	$T_{MIN} \leq T_J \leq T_{MAX}$	--	0.7	--	%/ V_{OUT}
Minimum Load Current for Regulation	$I_{L(MIN)}$	$V_{IN} - V_{OUT} = 40V$	--	3.5	10	mA
Maximum Output Current	$I_{O(MAX)}$	$V_{IN} - V_{OUT} = 40V$, $P_D \leq 20W$	0.2	0.3	--	A
Output Noise	E_{NO}	$BW = 10Hz$ to $10KHz$	--	0.003	--	%/ V_{OUT}

Note: C_{ADJ} is connected between Adjust pin and Ground.

● Typical Applications

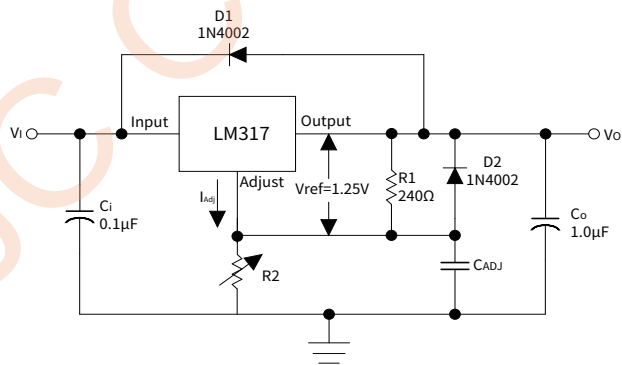


Figure 2.Internal Block Diagram

● Application Information

- R1 and R2 are required to set the output voltage.
- Use C_{ADJ} to improve ripple rejection. C_{ADJ} prevents amplification of the ripple when the output voltage is adjusted higher. The impact of C_{ADJ} on the ripple rejection performance is captured in the Electrical Characteristics table.
- C_i is recommended, particularly if the regulator is not in close proximity to the power-supply filter capacitors. A 0.1 μF or 1 μF ceramic or tantalum capacitor provides sufficient bypassing for most applications, especially when adjustment and output capacitors are used.
- C_o improves transient response, but is not needed for stability.
- Protection diode D2 is recommended if C_{ADJ} is used. The diode provides a low-impedance discharge path to prevent the capacitor from discharging into the output of the regulator.
- Protection diode D1 is recommended if C_o is used. The diode provides a low-impedance discharge path to prevent the capacitor from discharging into the output of the regulator.

● Feature Description

Overview

The LM317 is an adjustable three-pin, positive-voltage regulator capable of supplying up to 1A over an output voltage range of 1.3V to 37V. The device requires only two external resistors to set the output voltage. The device features a typical line regulation of 0.01% and typical load regulation of 0.1%. The LM317 includes current limiting, thermal overload protection, and safe operating area protection. Overload protection remains functional even if the ADJUST pin is disconnected.

The LM317 is designed to minimize the I_{ADJUST} current and make this current constant with line and load changes. A 100 μ A current from the ADJUST pin represents an error term.

NPN Darlington Output Drive

The NPN Darlington output topology provides naturally low output impedance and an output capacitor is optional. A 3V headroom is recommended ($V_I - V_O$) to support maximum current and lowest temperature.

Overload Block

Overcurrent and overtemperature shutdown protects the device against overload or damage from operating in excessive heat.

Programmable Feedback

An op amp with a 1.3V offset input at the ADJUST pin provides easy output voltage or current programming (but not both). For current regulation applications, use a single resistor whose resistance value is $1.3V / I_O$ and a power rating greater than $(1.3V)^2 / R$. For voltage regulation applications, two resistors set the output voltage.

● Device Functional Modes

Normal Operation

The device OUTPUT pin sources current necessary to make the OUTPUT pin 1.3V greater than ADJUST pin to provide output regulation.

Operation With Low Input Voltage

The device requires up to 3V headroom ($V_I - V_O$) to operate in regulation. The device potentially drops out and OUTPUT voltage becomes the INPUT voltage minus the dropout voltage with less headroom.

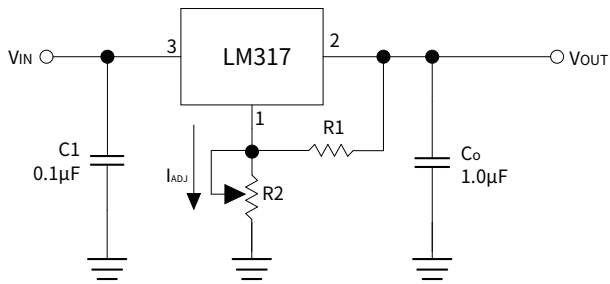
Operation at Light Loads

The device passes the bias current to the OUTPUT pin. Make sure the load or feedback consumes this minimum current for regulation or the output is potentially too high. See the Electrical Characteristics table for the minimum load current needed to maintain regulation.

Operation In Self Protection

When an overload occurs, the device shuts down the Darlington NPN output stage or reduces the output current to prevent device damage. The device automatically resets from the overload. The output is either reduced or alternates between on and off until the overload is removed.

● Application CircuitS



$V_{OUT} = 1.25V * (1 + R2/R1) + I_{ADJ} * R2$
C1 is required when regulator is located an appreciated distance from power supply.
Co is needed to improve transient response.

Fig.3 Programmable Voltage Regulator

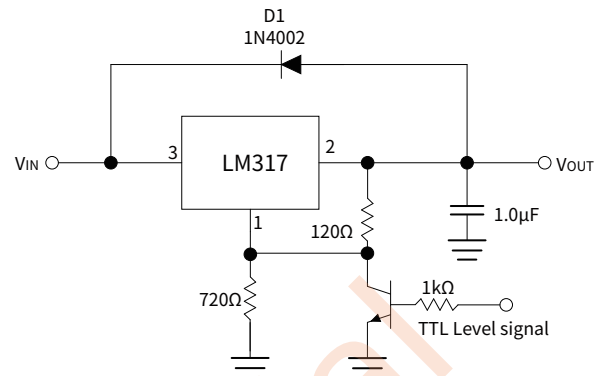


Fig.4 Regulator with On-off Control

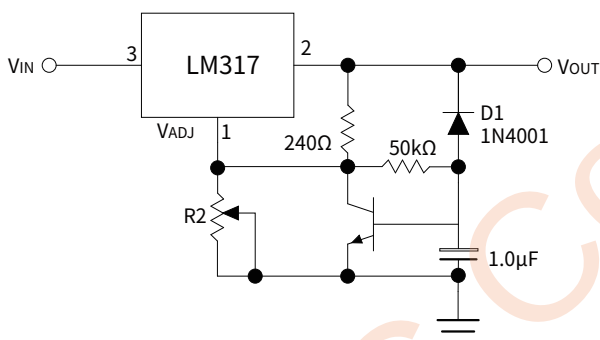
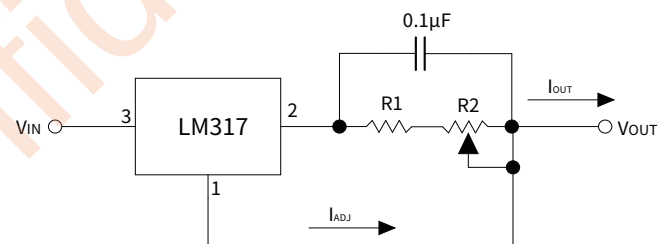


Fig.5 Soft Start Application



$$I_{O(MAX)} = \left(\frac{V_{REF}}{R1} \right) + I_{ADJ} = \frac{1.25V}{R1}$$

$$I_{O(MIN)} = \left(\frac{V_{REF}}{R1+R2} \right) + I_{ADJ} = \frac{1.25V}{R1+R2}$$

Fig.6 Constant Current Application

● Typical Performance Characteristics

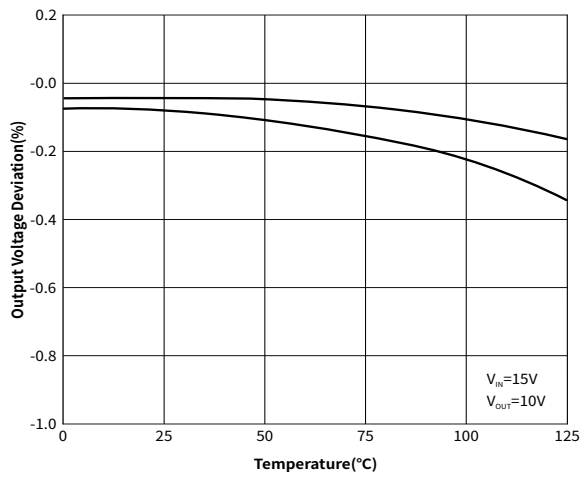


Fig.7 Load Regulation vs. Temperature

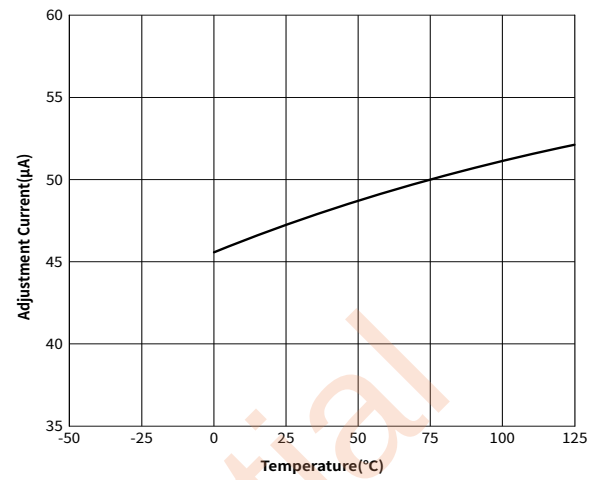


Fig.8 Adjustment Current vs. Temperature

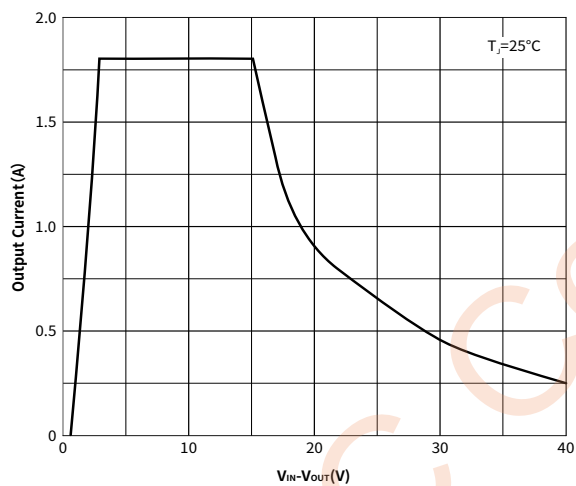


Fig.9 Current Limit

● Package Outline Dimensions (SOT-89)

Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
B	1.35	1.83	0.053	0.072
C	3.75	4.25	0.148	0.167
D	2.29	2.60	0.090	0.102
E	2.95	3.05	0.116	0.120
a	0.35	0.48	0.014	0.019
b	0.40	0.56	0.016	0.022
L	0.80	1.20	0.031	0.047
G	0.35	0.44	0.014	0.017
H	1.40	1.60	0.055	0.063

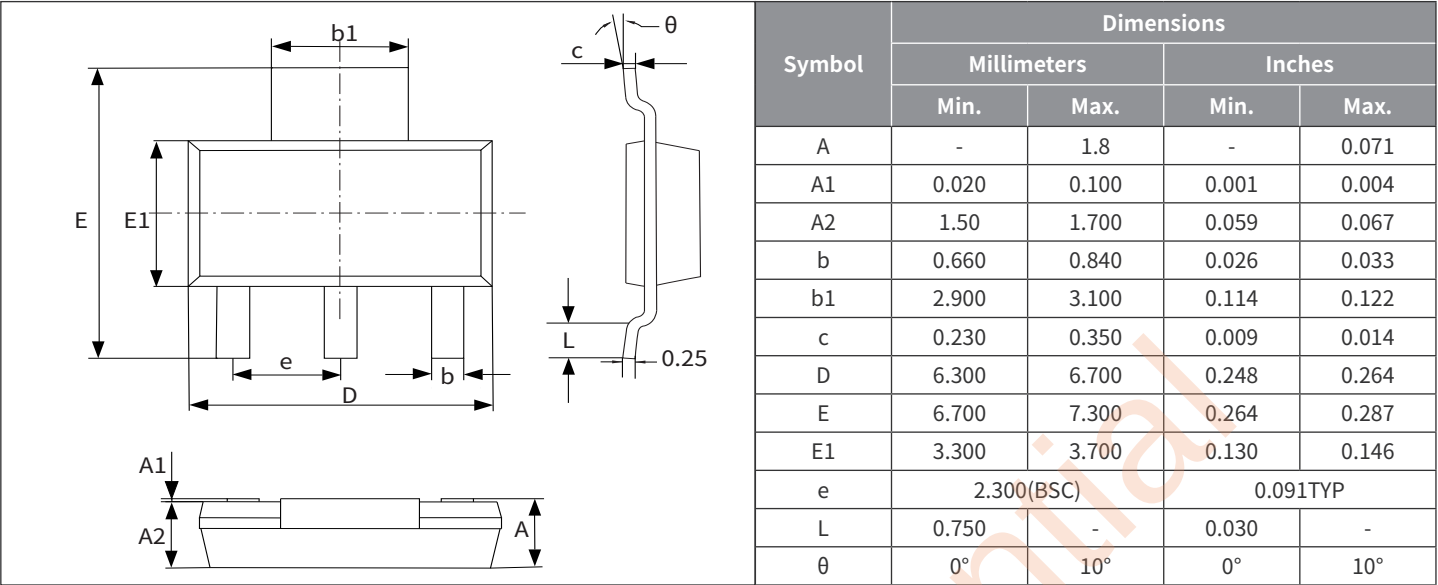
● Suggested Pad Layout

Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
c	0.80	1.00	0.032	0.04
d	1.30	1.50	0.052	0.060
e	0.70	0.90	0.028	0.036
J	1.80	2.00	0.072	0.080
K	1.40	1.60	0.056	0.064
X	2.50	2.70	0.100	0.108
X1	1.30	1.50	0.052	0.060
Y	4.30	4.50	0.172	0.180
Y1	3.10	3.30	0.124	0.132
θ	-	45°	-	45°

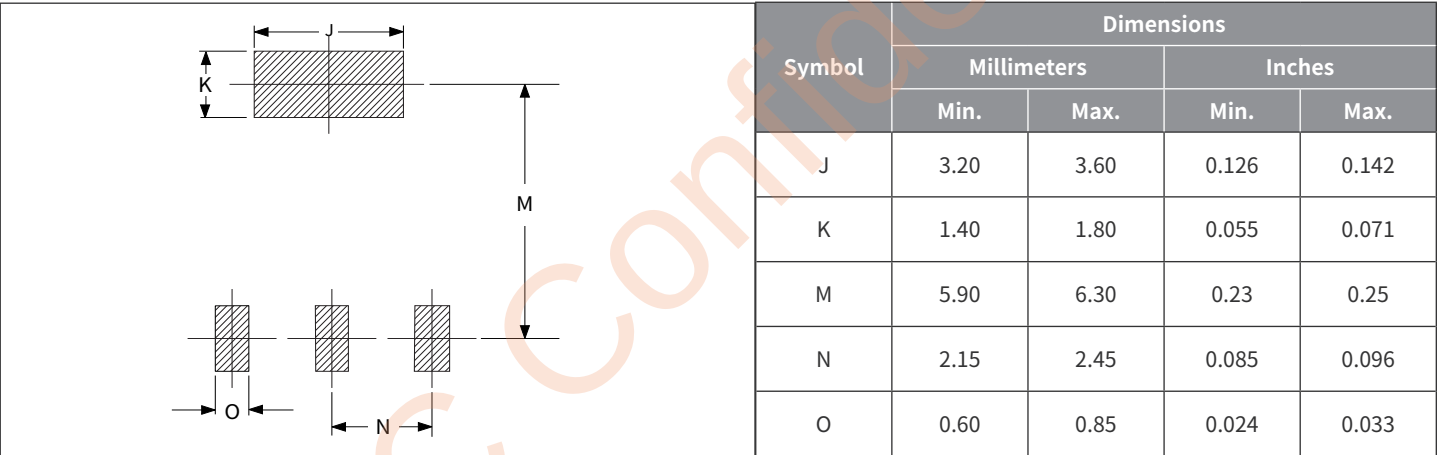
LM317 Series

Three-Terminal Adjustable Regulator

● **Package Outline Dimensions** (SOT-223)



● **Suggested Pad Layout**



● Package Outline Dimensions (TO-252)

Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	6.50	6.70	0.256	0.264
B	5.10	5.46	0.201	0.215
C	1.40	1.80	0.055	0.071
D	6.00	6.20	0.236	0.244
E	10.00	10.40	0.394	0.409
F	2.16	2.36	0.085	0.093
G	0.66	0.86	0.026	0.034
φ	1.05	1.35	0.041	0.053
H	0.46	0.58	0.018	0.023
J	2.20	2.40	0.087	0.094
K	-	0.30	-	0.012
L	0.89	2.29	0.035	0.090
M	2.73	3.08	0.107	0.121
N	0.43	0.58	0.017	0.023

● Suggested Pad Layout

Symbol	Dimensions			
	Millimeters		Inches	
	Min.	Max.	Min.	Max.
a	3.70	-	0.146	-
b	4.37	-	0.172	-
X	-	5.80	-	0.228
X1	-	1.20	-	0.047
Y	-	5.85	-	0.230
Y1	-	2.00	-	0.079

LM317 Series

Three-Terminal Adjustable Regulator

● Package Outline Dimensions (TO-220)

