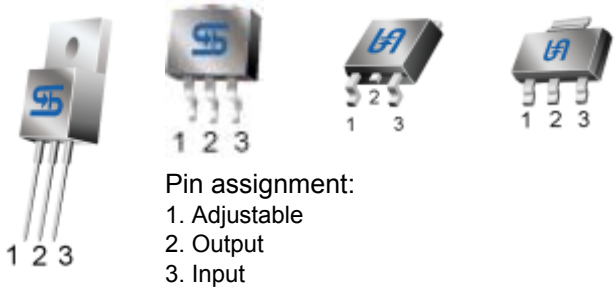
TS317

3-Terminal Adjustable Output Positive Voltage Regulator

TO-220 TO-263 TO-252 SOT-223



Pin assignment:
1. Adjustable
2. Output
3. Input
(Heatsink surface connected to pin 2)

Output Voltage Range From 1.25V to 37V
Output Current up to 1.5A

General Description

The TS317 is adjustable 3-terminal positive voltage regulator capable of supplying in excess of 1.5A over an output voltage range of 1.25 V to 37 V. This voltage regulator is exceptionally easy to use and require only two external resistors to set the output voltage. Further, it employs internal current limiting, thermal shutdown and safe area compensation, making it essentially blow-out proof.
The TS317 is offered in 3-pin TO-220, TO-263, TO-252 and SOT-223 package.

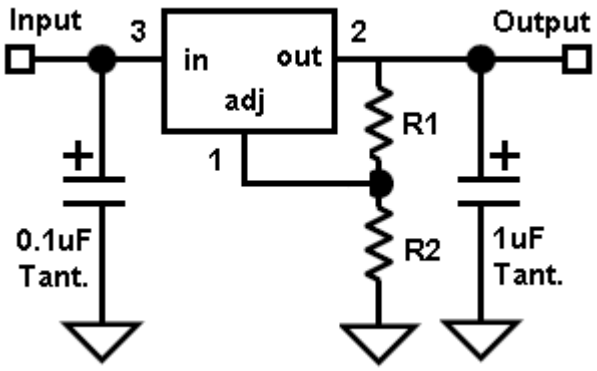
Features

- ✧ Output current up to 1.5A
  * TO-220/TO-263 for 1.5A
  * TO-252/SOT-223 for 500mA
- ✧ Output Adjustable between 1.25 V and 37 V
- ✧ Internal Thermal Overload Protection
- ✧ Internal Short-Circuit Current Limiting Constant with Temperature
- ✧ Output Transistor Safe-Area Compensation
- ✧ Floating Operation for High Voltage Applications
- ✧ Eliminates Stocking Many Fixed Voltages
- ✧ Output voltage offered in 4% tolerance

Ordering Information

Part No.	Operating Temp.	Package
TS317CZ	-20 ~ +150°C	TO-220
TS317CM		TO-263
TS317CP		TO-252
TS317CW		SOT-223

Standard Application



$Vout = 1.25\ V * (1 + R2 / R1) + Iadj_j * R2$

Since I_{Adj} is controlled to less than 100 μA, the error associated with this term is negligible in most applications
A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0V 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.

Absolute Maximum Rating

Input Voltage	Vin	40	V
Power Dissipation	Pd	Internal Limited	W
Operating Junction Temperature Range	T_J	-20 ~ +150	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

Electrical Characteristics

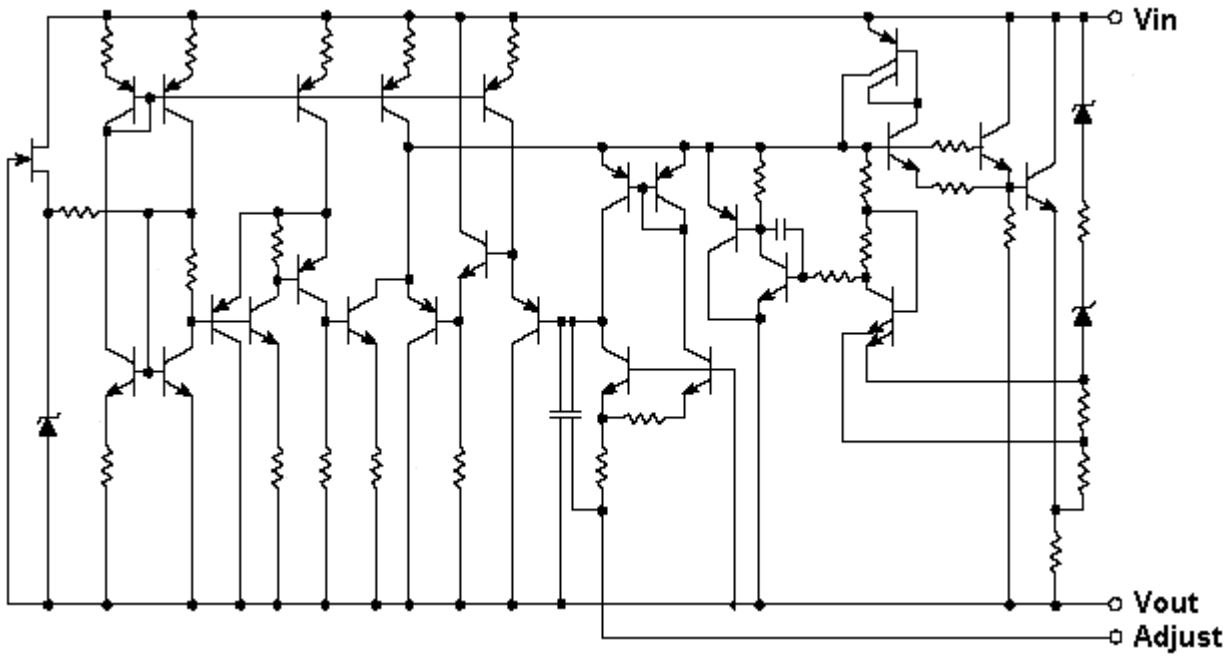
(V_I -V_O = 5.0 V, Io=500mA for TO-220/TO-263 packages, Io=200mA for TO-252/SOT-223 package;
Tj =T_{LOW} to T_{HIGH} see [Note 1]; Pmax per [Note 2]; unless otherwise specified.)

CHARACTERISTIC	FIGURE	SYMBOL	MIN.	TYP.	MAX.	UNIT
Reference voltage (Note 4) Pd ≤ Pmax, 10mA ≤ Io ≤ Imax, 3.0 V ≤ Vi - Vo ≤ 40 V	3	Vref	1.20	1.25	1.30	V
Line regulation (Note 3) Ta = 25 °C, 3.0 V ≤ Vi -Vo ≤ 40 V	1	REGline	--	0.01	0.07	%/V
Load regulation (Note 3) Ta = 25 °C, 10mA ≤ I_O ≤ Imax, V_O ≤ 5.0 V_O ≥ 5.0	2	REGload	-- --	5.0 0.1	25 0.5	mV %V
Thermal regulation Ta = 25 °C, 20 ms Pulse			--	0.03	0.07	%Vo/W
Adjustment pin current	3	Iadj	--	50	100	uA
Adjustment pin current change, Pd ≤ Pmax, 10mA ≤ Io ≤ Imax, 2.5V ≤ V_I - V_O ≤ 40V	1.2	ΔIadj	--	0.2	5.0	uA
Maximum output current Pd ≤ Pmax, (Vin-Vout) ≤15V CZ, CM Package CP, CW Package		Imax	 1.5 0.5			A
Temperature stability (T_{LOW} ≤ Tj ≤ T_{HIGH})	3	T_S	--	1	--	%
Minimum load current to maintain regulation (V_I - V_O = 40 V)	3	Imin	--	3.5	10	mA
RMS Noise, % of V_O, Ta =25 °C, 10H_Z ≤ f ≤ 10KH_Z	--	N	--	0.003	--	%
Long-term stability (Note 5), Tj = T_{HIGH} Ta =25 °C for endpoint measurements ,1000hrs	3	S	--	0.3	1.0	%

Notes:

1. T_{LOW} = -20 °C, T_{HIGH} = + 150°C
2. Pmax: CZ package=20W, CM package=3W, CP package=1.5W, CW package=0.8W,
3. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.
4. Selected devices with tightened tolerance reference voltage available.
5. Since Long-Term Stability cannot be measured on each device before shipment, this specification is an engineering estimate of average stability from lot to lot.
6. Cadj, when used, is connected between the adjustment pin and ground.

Block Diagram



Test Circuit

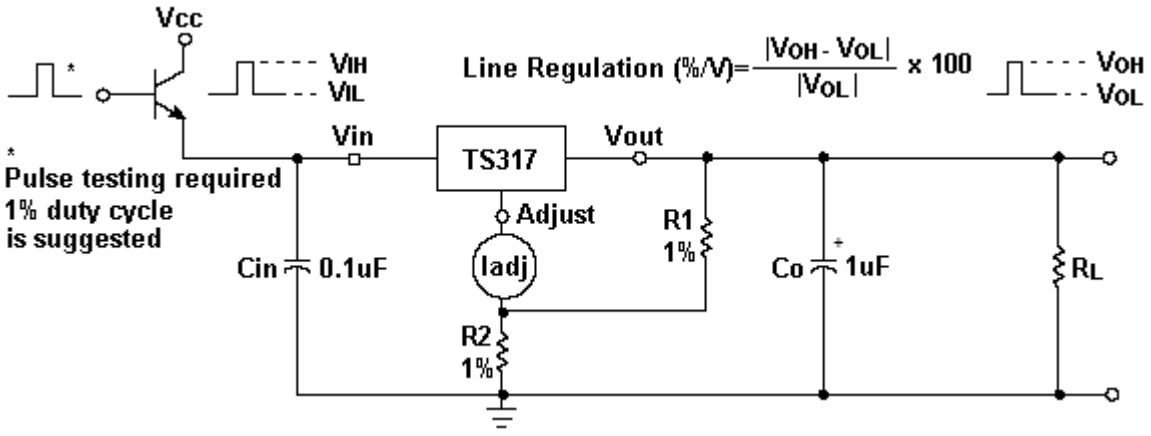


Figure 1. line regulation and ΔIadj/line test circuit

Test Circuit

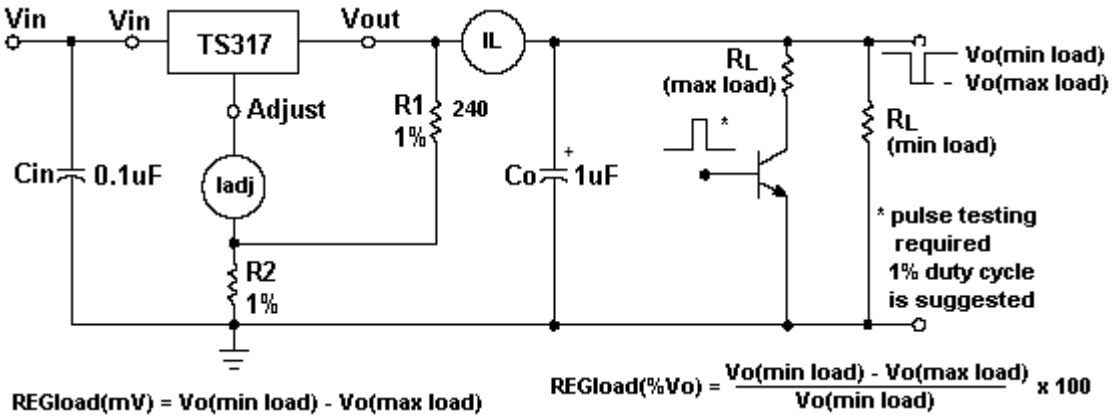


Figure 2. load regulation and Δladj/line test circuit

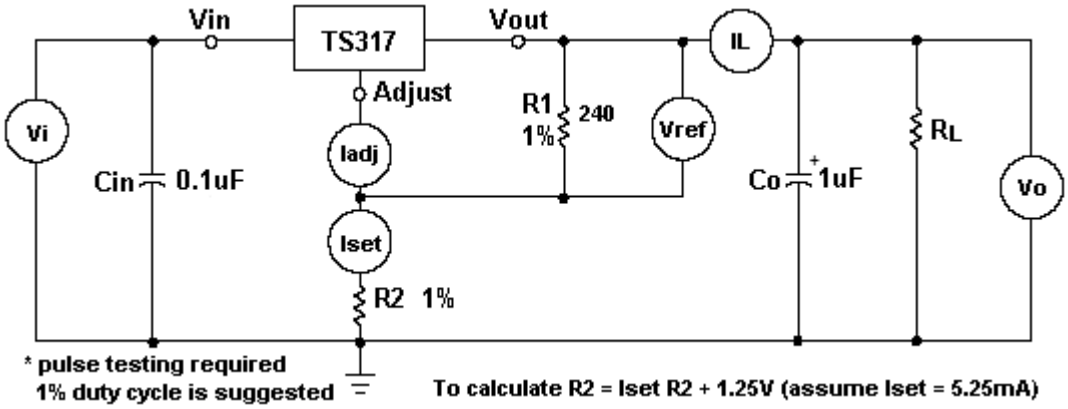


Figure 3. standard test circuit

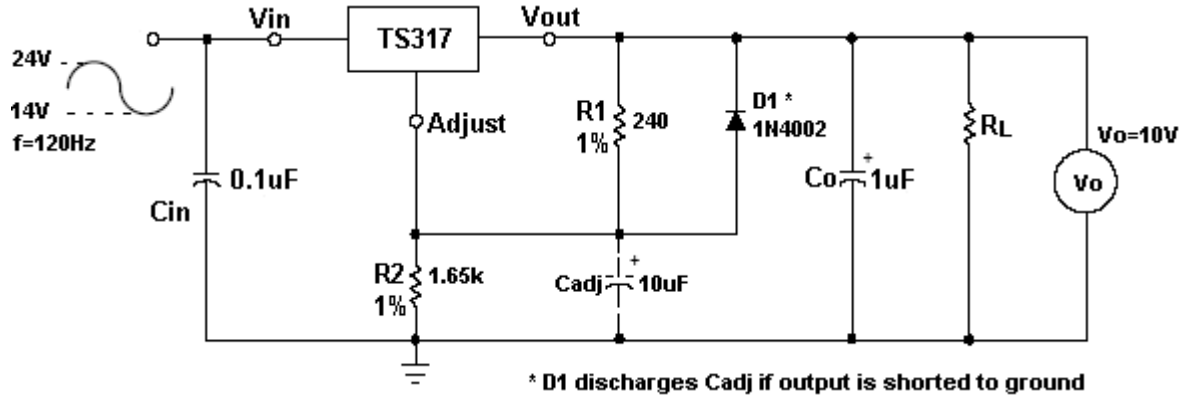


Figure 4. ripple rejection test circuit

Application Information

Basic Circuit Operation

The TS317 is a 3-terminal floating regulator. In operation, the TS317 develops and maintains a nominal 1.25V reference (Vref) between its output and adjustment terminals. This reference voltage is converted to a programming current (Iprog.) by R_1 (see Figure 17), and this constant current flows through R_2 to ground. The regulated output voltage is given by:

Vout = Vref (1 + R2 / R1) + Iadj * R2

Since the current from the adjustment terminal (Iadj) represents an error term in the equation, the TS317 was designed to control Iadj to less than 100uA and keep it constant. To do this, all quiescent operating current is returned to the output terminal. This imposes the requirement for a minimum load current. If the load current is less than this minimum, the output voltage will rise.

Since the TS317 is a floating regulator, it is only the voltage differential across the circuit which is important to performance, and operation at high voltages with respect to ground is possible.

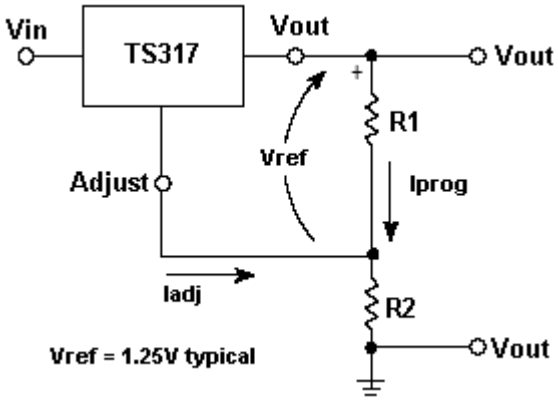


Figure 5. basic circuit configuration

Load Regulation

The TS317 is capable of providing extremely good load regulation, but a few precautions are needed to obtain maximum performance. For best performance, the programming resistor (R1) should be connected as close to the regulator as possible to minimize line drops which effectively appear in series with the reference, thereby degrading regulation. The ground end of R2 can be returned near the load ground to provide remote ground sensing and improve load regulation.

External Capacitor

A 0.1μF disc or 1μF tantalum input bypass capacitor (Cin) is recommended to reduce the sensitivity to input line impedance.

The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor (Cadj) prevents ripple from being amplified as the output voltage is rejection about 15dB at 120 H_Z in a 10V application.

Although the TS317 is stable with no output capacitance, like any feedback circuit, certain values of external capacitance can cause excessive ringing. An output increased. A 10uμF capacitor should improve ripple capacitance (Co) in the form of a 1uF tantalum or 25uF aluminum electrolytic capacitor on the output swamps this effect and insures stability.

Protection Diode

When external capacitors are used with any I.C. regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator.

Figure 18 shows the TS317 with the recommended protection diodes for output voltages in excess of 25 V or high capacitance values (Co > 25uF, Cadj > 10uF). Diode D1 prevents Co from discharging thru the I.C. during an input short circuit. Diode D2 protects against capacitor C_{ADJ} discharging through the I.C. during an output short circuit. The combination of diodes D1 and D2 prevents C_{ADJ} from discharging through the I.C. during an input short circuit.

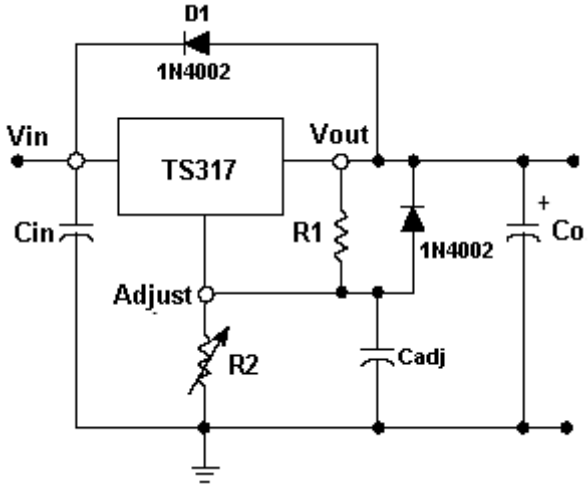


Figure 6. voltage regulator with protection diode

Application Information

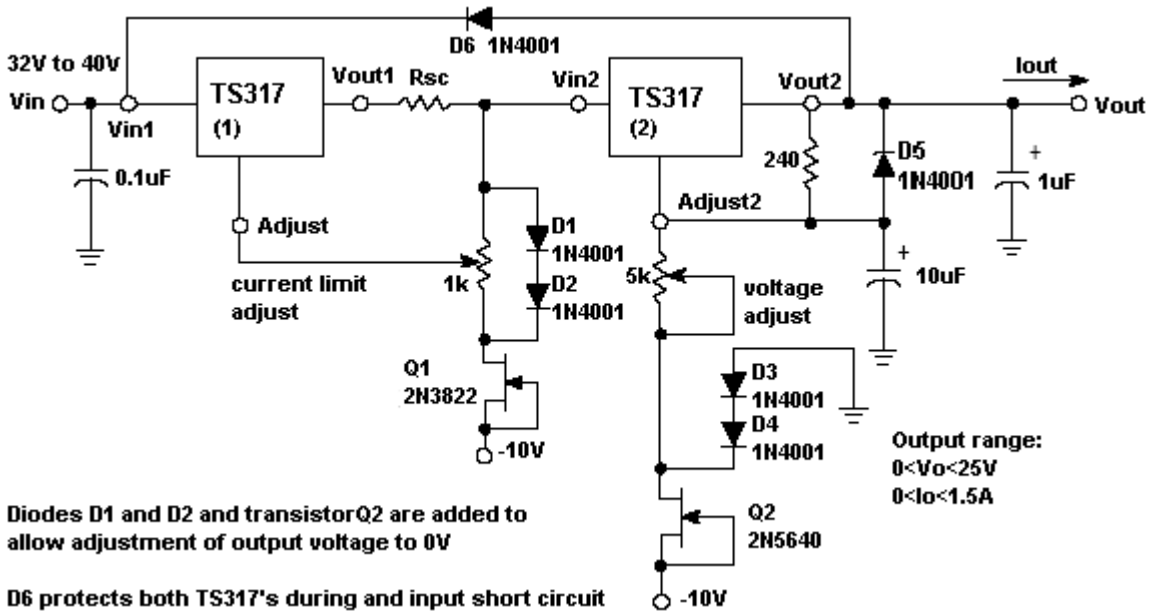


Figure 7. "LABORATORY" power supply with adjustable current limit and output voltage

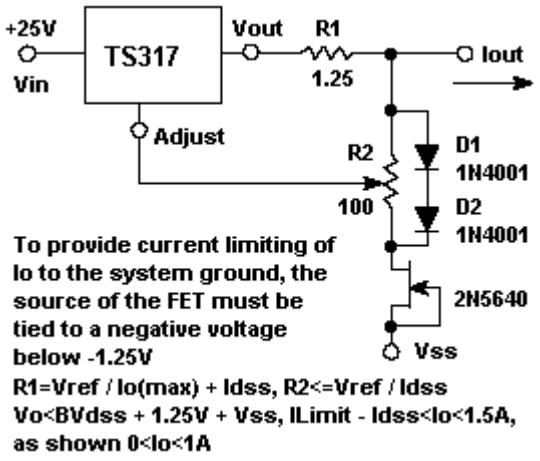


Figure 8. adjustable current limiter

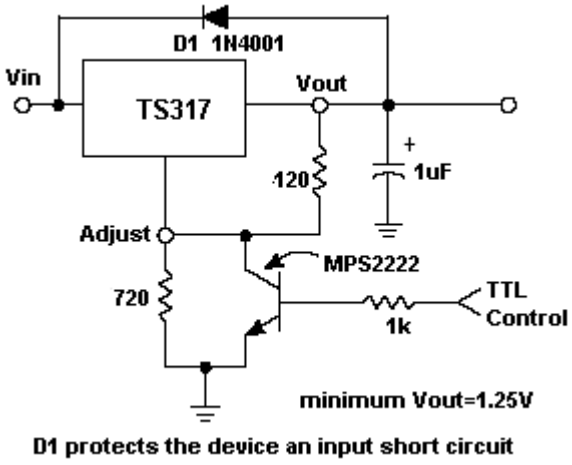


Figure 9. 5V electronic shutdown regulator

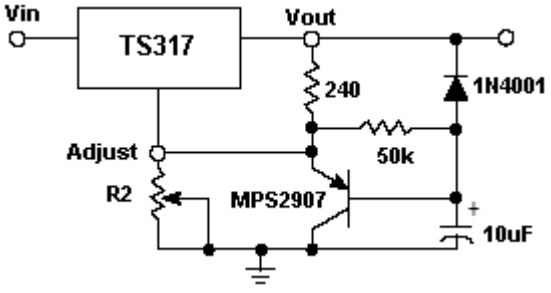


Figure10. slow turn-on regulator

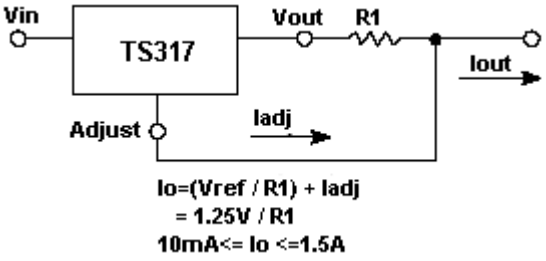
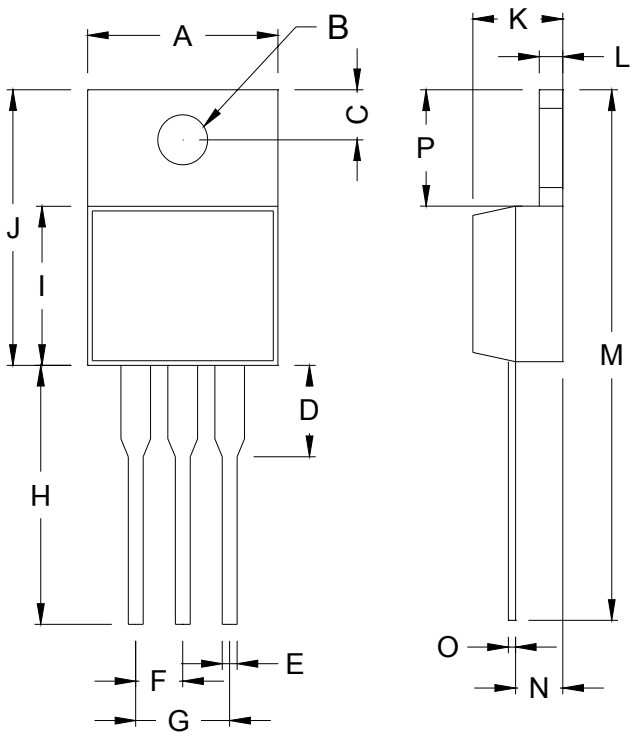


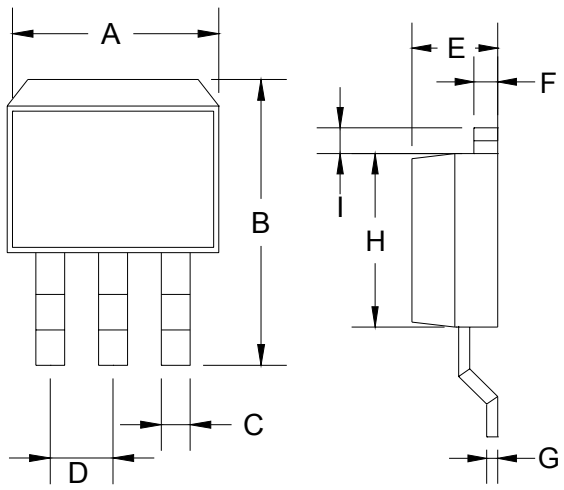
Figure 11. current regulator

TO-220 Mechanical Drawing



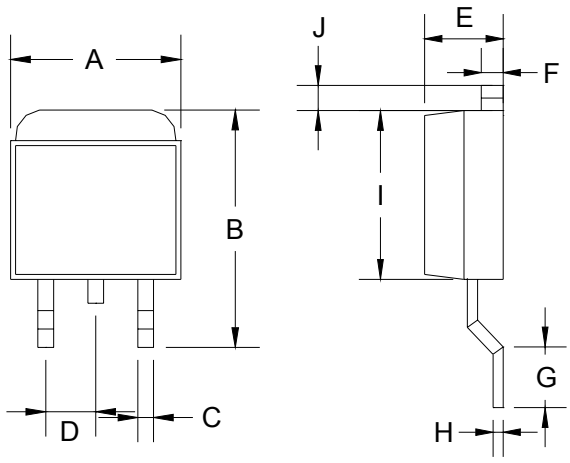
TO-220 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	3.240	4.440	0.128	0.175
C	2.440	2.940	0.096	0.116
D	-	6.350	-	0.250
E	0.381	1.106	0.015	0.040
F	2.345	2.715	0.092	0.058
G	4.690	5.430	0.092	0.107
H	12.700	14.732	0.500	0.581
I	8.382	9.017	0.330	0.355
J	14.224	16.510	0.560	0.650
K	3.556	4.826	0.140	0.190
L	0.508	1.397	0.020	0.055
M	27.700	29.620	1.060	1.230
N	2.032	2.921	0.080	0.115
O	0.255	0.610	0.010	0.024
P	5.842	6.858	0.230	0.270

TO-263 Mechanical Drawing



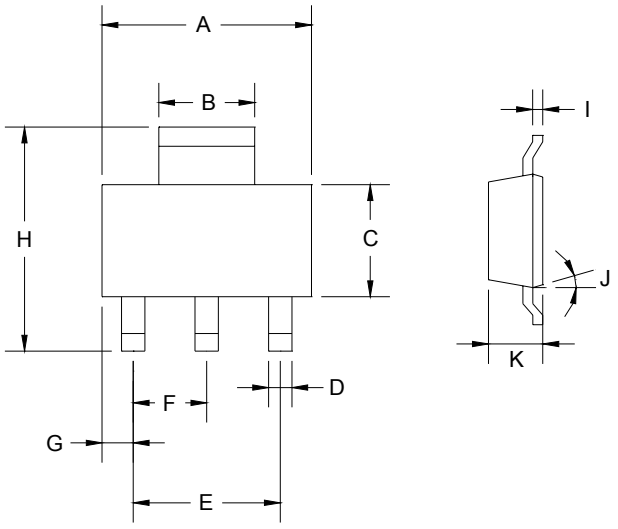
TO-263 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.000	10.500	0.394	0.413
B	14.605	15.875	0.575	0.625
C	0.508	0.991	0.020	0.039
D	2.420	2.660	0.095	0.105
E	4.064	4.830	0.160	0.190
F	1.118	1.400	0.045	0.055
G	0.450	0.730	0.018	0.029
H	8.280	8.800	0.325	0.346
I	1.140	1.400	0.044	0.055
J	1.480	1.520	0.058	0.060

TO-252 Mechanical Drawing



TO-252 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.570	6.840	0.259	0.269
B	9.250	10.400	0.364	0.409
C	0.550	0.700	0.022	0.028
D	2.560	2.670	0.101	0.105
E	2.300	2.390	0.090	0.094
F	0.490	0.570	0.019	0.022
G	1.460	1.580	0.057	0.062
H	0.520	0.570	0.020	0.022
I	5.340	5.550	0.210	0.219
J	1.460	1.640	0.057	0.065

SOT-223 Mechanical Drawing



SOT-223 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.350	6.850	0.250	0.270
B	2.900	3.100	0.114	0.122
C	3.450	3.750	0.136	0.148
D	0.595	0.635	0.023	0.025
E	4.550	4.650	0.179	0.183
F	2.250	2.350	0.088	0.093
G	0.835	1.035	0.032	0.041
H	6.700	7.300	0.263	0.287
I	0.250	0.355	0.010	0.014
J	10°	16°	10°	16°
K	1.550	1.800	0.061	0.071