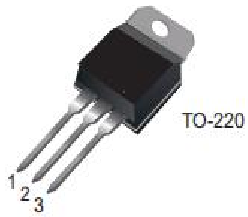
General Description

The L7805 Family monolithic 3-terminal positive voltage regulators emplOy internal currentlimiting, thermal shutdown and safe-area compensation, making them essentially indestructible. If adequate heat sinking is provided, they can deliver over 1.5-A output current. They are intended as fixed voltage regulators in a wide range of applications including lOcal (on-card) regulation for elimination of noise and distribution problems associated with single-point regulation. In addition to use as fixed voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents.



Considerable effort was expended to make the entire series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is lOcated far from the filter capacitor of the power supply.

Features

- Output Current up to 1.5 A
- Available in Fixed 5-V, 12-V, and 15-V Options
- Internal Thermal OverlOad, Short-Circuit and SOA Protection
- Available in Space-SaVINg SOT-223 Package
- Output Capacitance Not Required for Stability

Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing QTY
L7805CV	TO-220	L7805CV	Tube	1000/BOX

Applications

- Industrial Power Supplies
- SMPS Post Regulation
- HVAC Systems
- AC Inventors
- Test and Measurement Equipment
- Brushed and Brushless DC Motor Drivers
- Solar Energy String Invertors

Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
INPUT	1	I	Input voltage pin
GND	2	I/O	Ground pin
OUTPUT	3	O	Output voltage pin

Absolute Maximum Ratings

		MIN	MAX	UNIT
DC input voltage			35	V
Internal power dissipation(3)		Internally Limited		
Maximum junction temperature			150	℃
Lead temperature (soldering, 10 sec.)	TO-3 package (NDS)		300	℃
	Lead temperature 1,6 mm (1/16 in) from case for 10 s		230	℃
Storage temperature		-65	150	℃

(1)Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2)If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
(3)The maximum allOwable power dissipation at any ambient temperature is a function of the maximum junction temperature for operation (TJMAX = 125℃ or 150℃), the junction-to-ambient thermal resistance (θJA), and the ambient temperature (TA). PDMAX = (TJMAX − TA)/θJA. If this dissipation is exceeded, the die temperature rises above TJMAX and the electrical specifications do not apply. If the die temperature rises above 150℃, the device goes into thermal shutdown. For the TO-3 package (NDS), the junction-to-ambient thermal resistance (θJA) is 39 ℃/W. When using a heat sink, θJA is the sum of the 4℃/W junction-to-case thermal resistance (θJC) of the TO-3 package and the case-to-ambient thermal resistance of the heat sink. For the TO-220 package (NDE), θJA is 54 ℃/W and θJC is 4℃/W.

ESD Ratings

			MAX	UNIT
$V_{(ESD)}$	Electrostatic dischareg	Human-body model(HBM)(1)	±2000	V

(1)ESD rating is based on the human-body model, 100pF discharged through 1.5kΩ.

Thermal Information

THERMAL METRIC(1)		L7805 Family NDE (TO-220)	UNIT
$R\theta_{JA}$	Junction-to-ambient thermal resistance	23.9	℃/W
$R\theta_{JC(top)}$	Junction-to-case (top) thermal resistance	16.7	℃/W
$R\theta_{JB}$	Junction-to-board thermal resistance	5.3	℃/W
ψJT	Junction-to-top characterization parameter	3.2	℃/W

ψJB	Junction-to-board characterization parameter	5.3	℃/W
$R\theta_{JC(bot)}$	Junction-to-case (bottom) thermal resistance	1.7	℃/W

(1)For more information about traditional and new thermal metrics, see the Semiconductor and IC Package Thermal Metrics application report.

Electrical Characteristics(VO=5V,VI=10V,0℃≤TJ≤125℃ unless otherwise specified(1))

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O Output voltage		T_J=25℃,5 mA≤I_O≤1A		4.8	5	5.2	V
		P_D≤15W,5 mA≤I_O≤1A 7.5V≤V_{IN}≤20V		4.75		5.25	V
ΔV_O Line regulation		I_O=500mA	T_J=25℃ 7V≤V_{IN}≤25V		3	50	mV
			Over temperature 8V≤V_{IN}≤20V			50	mV
		I_O≤1A	T_J=25℃ 7.5V≤V_{IN}≤20V			50	mV
			Over temperature 8V≤V_{IN}≤12V			25	mV
ΔV_O IOad regulation		T_J=25℃	5mA≤I_O≤1.5A		10	50	mV
			250mA≤I_O≤750mA			25	mV
		Over temperature,5mA≤I_O≤1A				50	mV
I_Q Quiescent current		I_O≤1A	T_J =25℃			8	mA
			Over temperature			8.5	mA
ΔI_Q Quiescent current change		0℃≤T_J≤125℃,5mA≤I_O≤1A			0.5		mA
		7V≤V_{IN}≤20V	T_J=25℃,I_O≤1A			1	mA
			Over temperature, I_O≤ 500mA			1	mA
V_N Output noise voltage		T_A=25℃,10Hz≤f≤100kHz			40		μV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$ Ripple rejection		f=120Hz 8V≤V_{IN}≤18V	T_J=25℃,I_O≤1A	62	80		dB
			Over temperature, I_O≤500mA	62			dB
R_O	Dropout voltage	T_J=25℃,I_O=1A			2		V
	Output resistance	f=1kHz			8		mQ
	Short-circuit current	T_J=25℃			2.1		A
	Peak output current	T_J=25℃			2.4		A
	Average TC of Vout	Over temperature, I_O = 5 mA			-0.6		mV/℃
V_{IN} Input voltage required to maintain line regulation		T_J=25℃,I_O≤1A		7.5			V

(1)All characteristics are measured with a 0.22-μF capacitor from input to ground and a 0.1-μF capacitor from output to ground. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques (tw ≤ 10 ms, duty cycle ≤ 5%). Output voltage changes due to changes in internal temperature must be taken into account separately.

Typical Characteristics

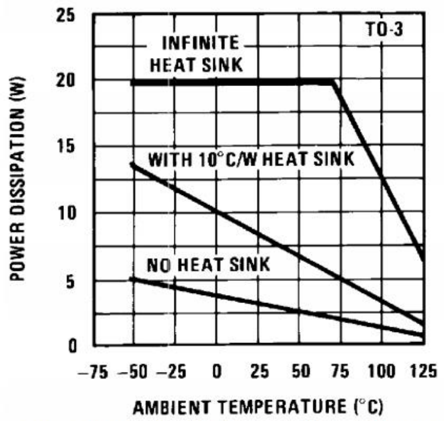


Figure 1. Maximum Average Power Dissipation

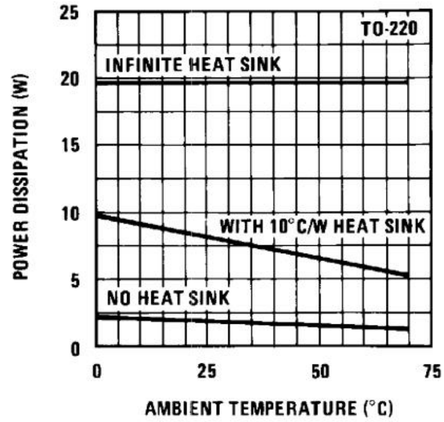


Figure 2. Maximum Average Power Dissipation

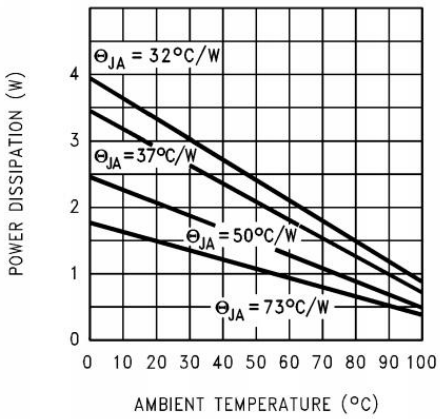


Figure 3. Maximum Power Dissipation (DDPAK/TO-263)

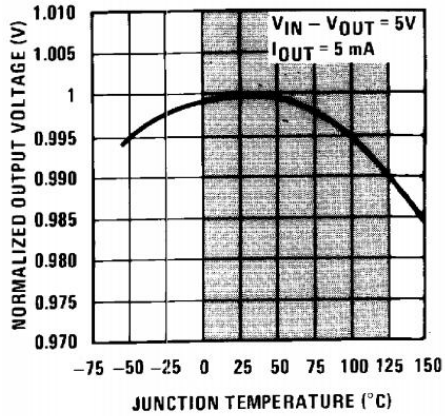


Figure 4. Output Voltage (Normalized to 1 V at T_J = 25°C)

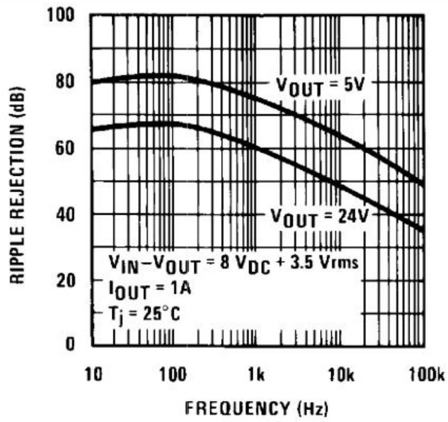


Figure 5. Ripple Rejection

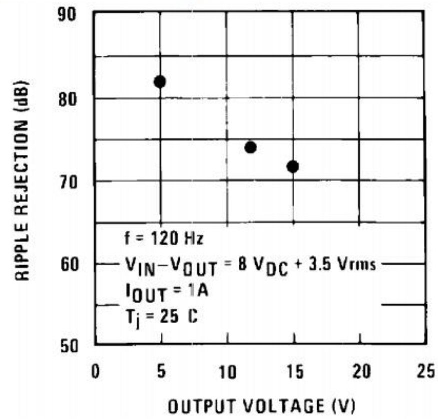


Figure 6. Ripple Rejection

Typical Characteristics (continued)

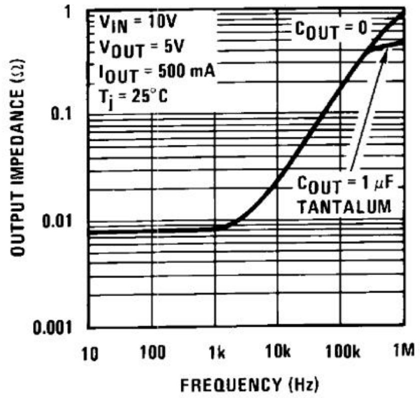


Figure 7. Output Impedance

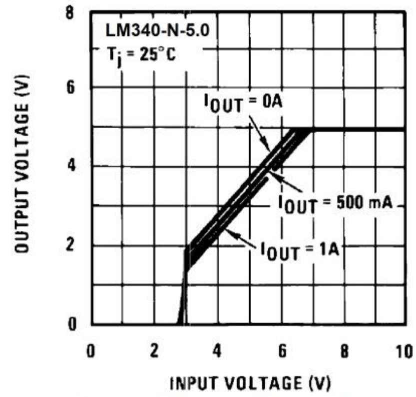


Figure 8. Dropout Characteristics

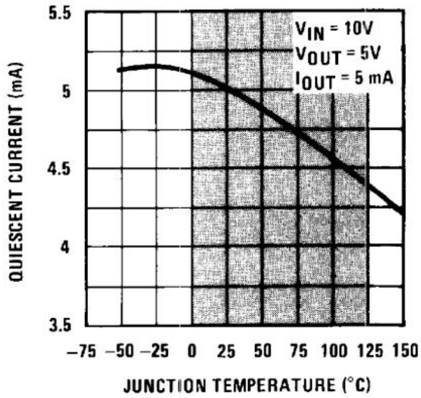


Figure 9. Quiescent Current

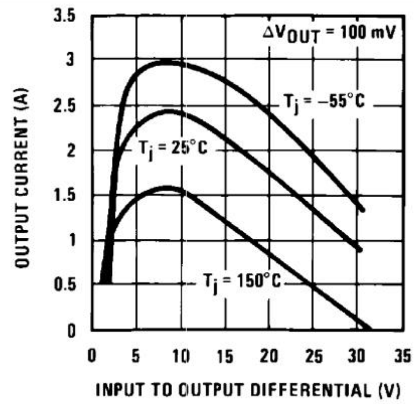


Figure 10. Peak Output Current

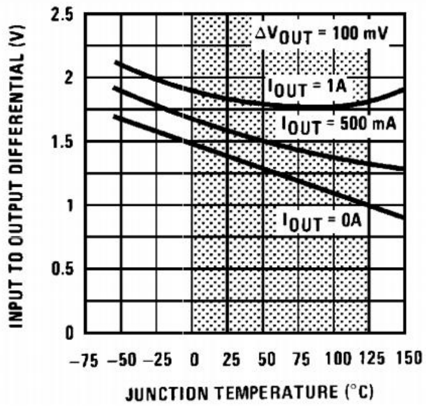


Figure 11. Dropout Voltage

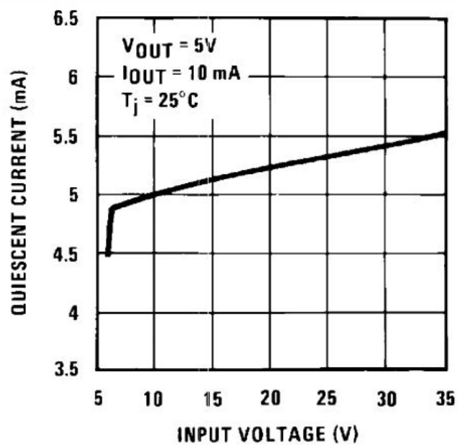
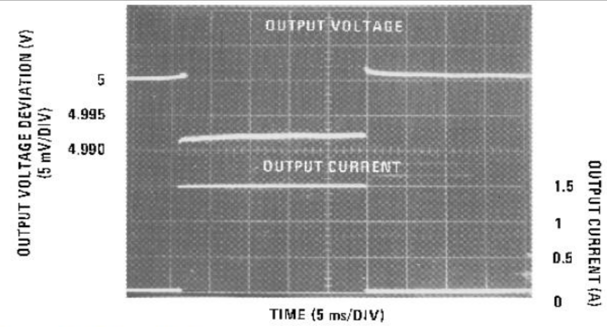
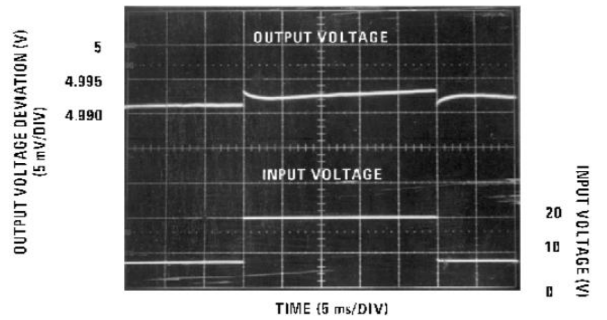


Figure 12. Quiescent Current



I_{OUT} = 1 A, T_A = 25°C

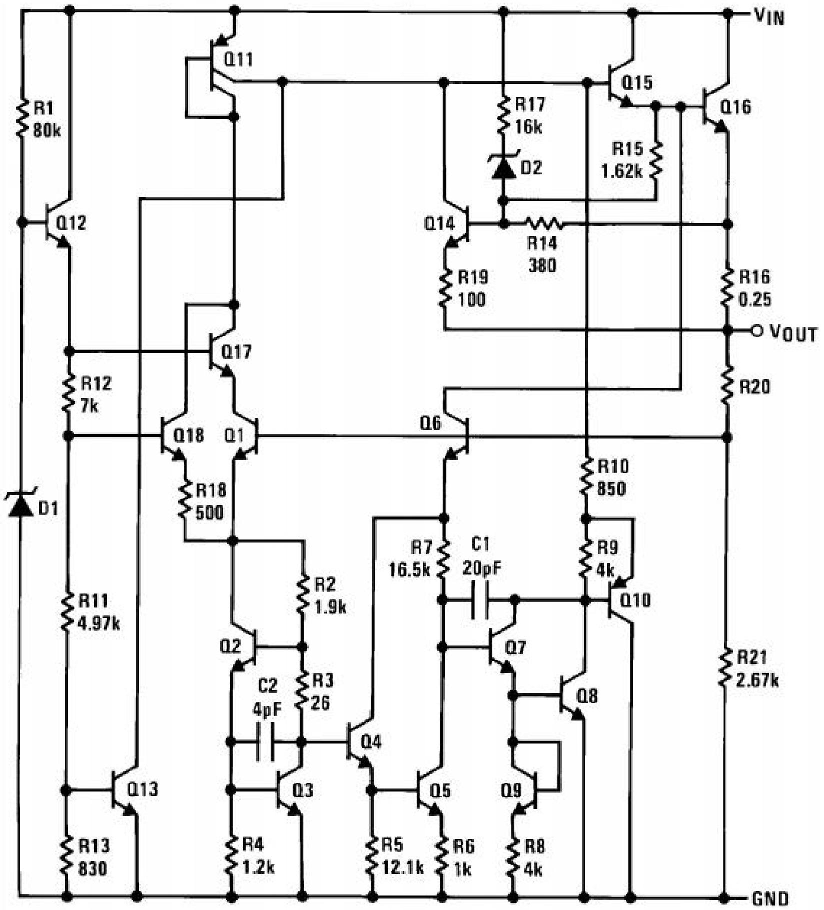
Figure 13. Line Regulation LM340



V_{IN} = 10 V, T_A = 25°C

Figure 14. Line Regulation LM340

Typical Characteristics (continued)



Application Information

The L7805 series is designed with thermal protection, output short-circuit protection, and output transistor safe area protection. However, as with any IC regulator, it becomes necessary to take precautions to assure that the regulator is not inadvertently damaged. The following describes possible misapplications and methods to prevent damage to the regulator.

Shorting the Regulator Input

When using large capacitors at the output of these regulators, a protection diode connected input to output (Figure 15) may be required if the input is shorted to ground. Without the protection diode, an input short causes the input to rapidly approach ground potential, while the output remains near the initial VOUT because of the stored charge in the large output capacitor. The capacitor will then discharge through a large internal input to output diode and parasitic transistors. If the energy released by the capacitor is large enough, this diode, low current metal, and the regulator are destroyed. The fast diode in Figure 15 shunts most of the capacitors discharge current around the regulator. Generally no protection diode is required for values of output capacitance

≤ 10 µF.

Raising the Output Voltage Above the Input Voltage

Because the output of the device does not sink current, forcing the output high can cause damage to internal low current paths in a manner similar to that just described in Shorting the Regulator Input.

Regulator Floating Ground

When the ground pin alone becomes disconnected, the output approaches the unregulated input, causingpossible damage to other circuits connected to VOUT. If ground is reconnected with power ON, damage may also occur to the regulator. This fault is most likely to occur when plugging in regulators or modules with on card regulators into powered up sockets. The power must be turned off first, the thermal limit ceases operating, or the ground must be connected first if power must be left on. See Figure 16.

Transient Voltages

If transients exceed the maximum rated input voltage of the device, or reach more than 0.8V below ground and have sufficient energy, they will damage the regulator. The solution is to use a large input capacitor, a series input breakdown diode, a choke, a transient suppressor or a combination of these.

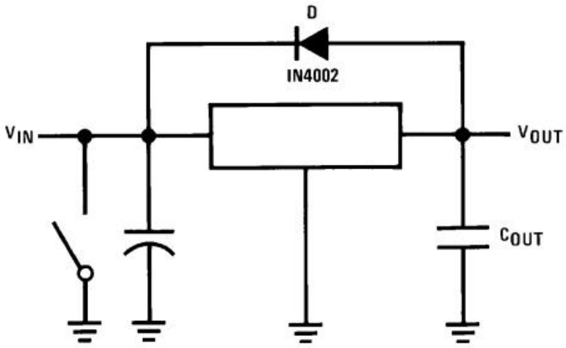


Figure 15. Input Short

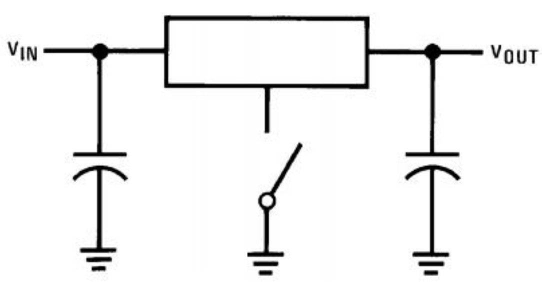


Figure 16. Regulator Floating Ground

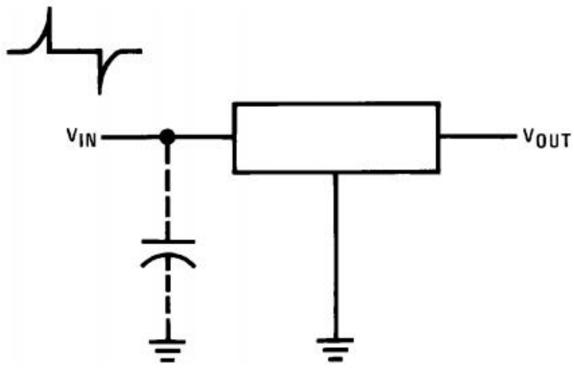


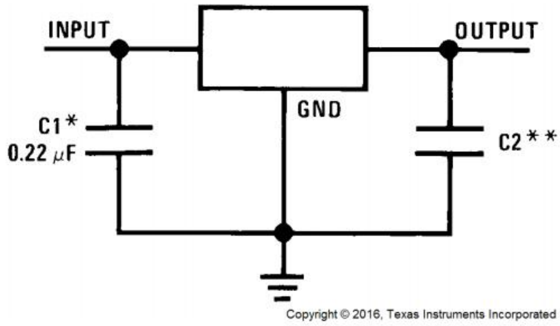
Figure 17. Transients

When a value for $\theta_{(H\text{–}A)}$ is found, a heat sink must be selected that has a value that is less than or equal to this number.

$\theta_{(H\text{–}A)}$ is specified numerically by the heat sink manufacturer in this catalog or shown in a curve that plots temperature rise vs power dissipation for the heat sink.

Fixed Output Voltage Regulator

The L7805 Family devices are primarily designed to provide fixed output voltage regulation. The simplest implementation of L7805 Family is shown in Figure18.



*Required if the regulator is located far from the power supply filter.
**Although no output capacitor is needed for stability, it does help transient response. (If needed, use 0.1-μF, ceramic disc).

Figure 18. Fixed Output Voltage Regulator

Design Requirements

The device component count is very minimal. Although not required, TI recommends employing bypass capacitors at the output for optimum stability and transient response. These capacitors must be placed as close as possible to the regulator. If the device is located more than 6 inches from the power supply filter, it is required to employ input capacitor.

Detailed Design Procedure

The output voltage is set based on the device variant. LM340x and L7805 Family are available in 5-V, 12-V and 15-V regulator options.

Application Curve

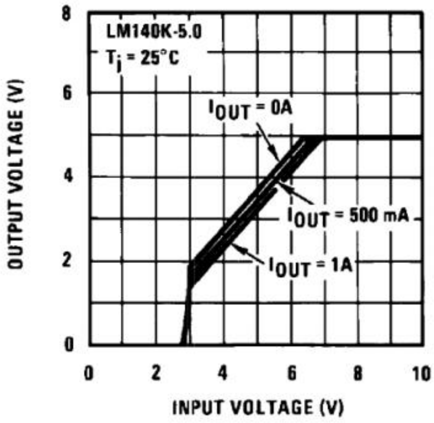
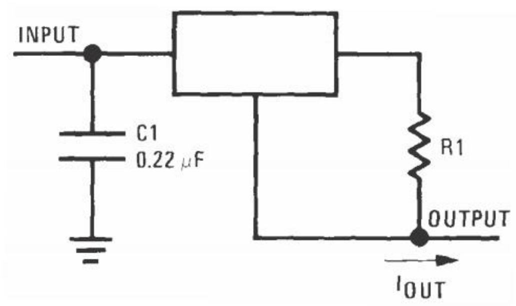
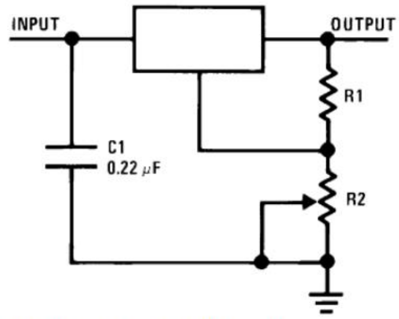


Figure 19. V_{OUT} vs V_{IN}, V_{OUT} = 5V

System Examples

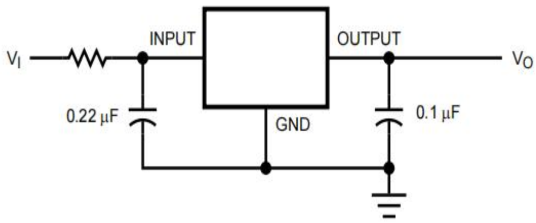


$I_{OUT} = V2–3 / R1 + I_Q$
ΔI_Q = 1.3 mA over line and load changes.



V_{OUT} = 5 V + (5 V/R1 + I_Q) R2 5 V/R1 > 3 I_Q,
load regulation (L_r) ≈ [(R1 + R2)/R1] (L_r of LM340-5).

Figure 20. Current Regulator Figure 21. Adjustable Output Regulator



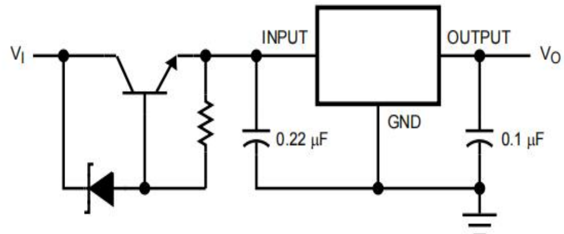
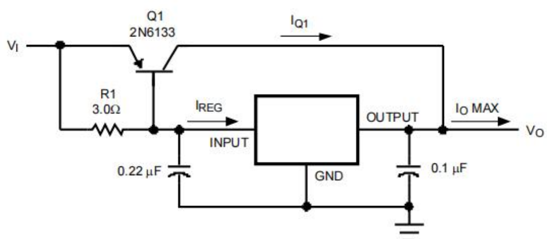
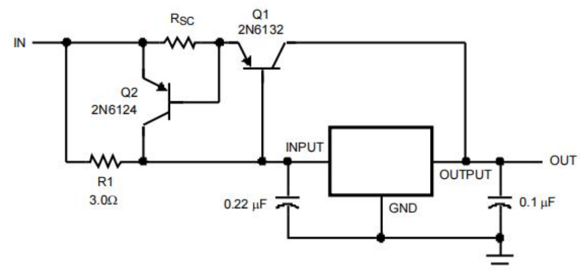


Figure 22. High Input Voltage Circuit With Series Figure 23. High Input Voltage Circuit

implementation With Transistor





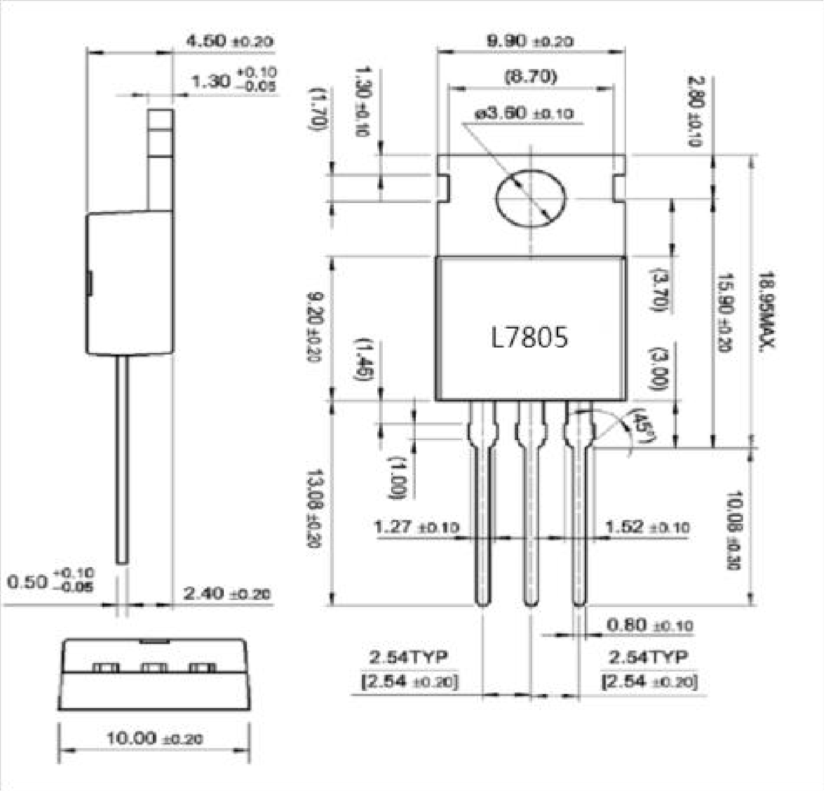
$\beta(Q1) \geq I_{O\ Max} / I_{REG\ Max}$
$R1 = 0.9 / I_{REG} = \beta_{(Q1)} V_{BE(Q1)} / I_{REG\ Max\ (\beta+1)} - I_{O\ Max}$

$R_{SC} = 0.8 / I_{SC}$
$R1 = \beta V_{BE(Q1)} / I_{REG\ Max} (\beta + 1) - I_{O\ Max}$

Figure 24. High Current Voltage Regulatorure Figure25. High Output Current With Short-Circuit Protection

Outline Drawing

TO220	Unit:mm



Statement：

✧ Shenzhen xinbole electronics co., ltd. reserves the right to change the product specifications, without notice! Before placing an order, the customer needs to confirm whether the information obtained is the latest version, and verify the integrity of the relevant information.

✧ Any semiconductor product is liable to fail or malfunction under certain conditions, and the buyer shall be responsible for complying with safety standards in the system design and whole machine manufacturing using Shenzhen xinbole electronics co., ltd products, and take appropriate security measures to avoid the potential risk of failure may result in personal injury or property losses of the situation occurred!

✧ Product performance is never ending, Shenzhen xinbole electronics co., ltd will be dedicated to provide customers with better performance, better quality of integrated circuit products.