

LM78XX

Series Voltage Regulators

General Description

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment, although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents.

The LM78XX series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Considerable effort was expended to make the LM78XX 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 by-passing is needed only if the regulator is located far from the filter capacitor of the power supply.

For output voltage other than 5V, 12V and 15V the LM117 series provides an output voltage range from 1.2V to 57V.

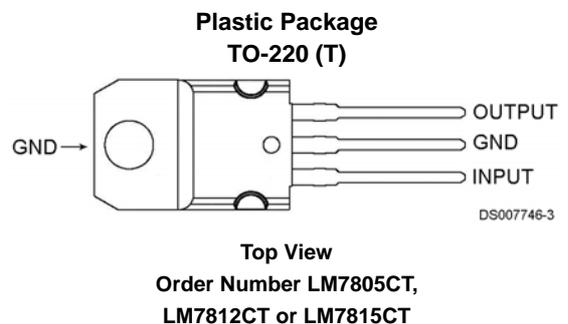
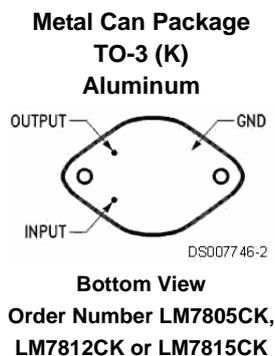
Features

- Output current in excess of 1A
- Internal thermal overload protection
- No external components required
- Output transistor safe area protection
- Internal short circuit current limit
- Available in the aluminum TO-3 package

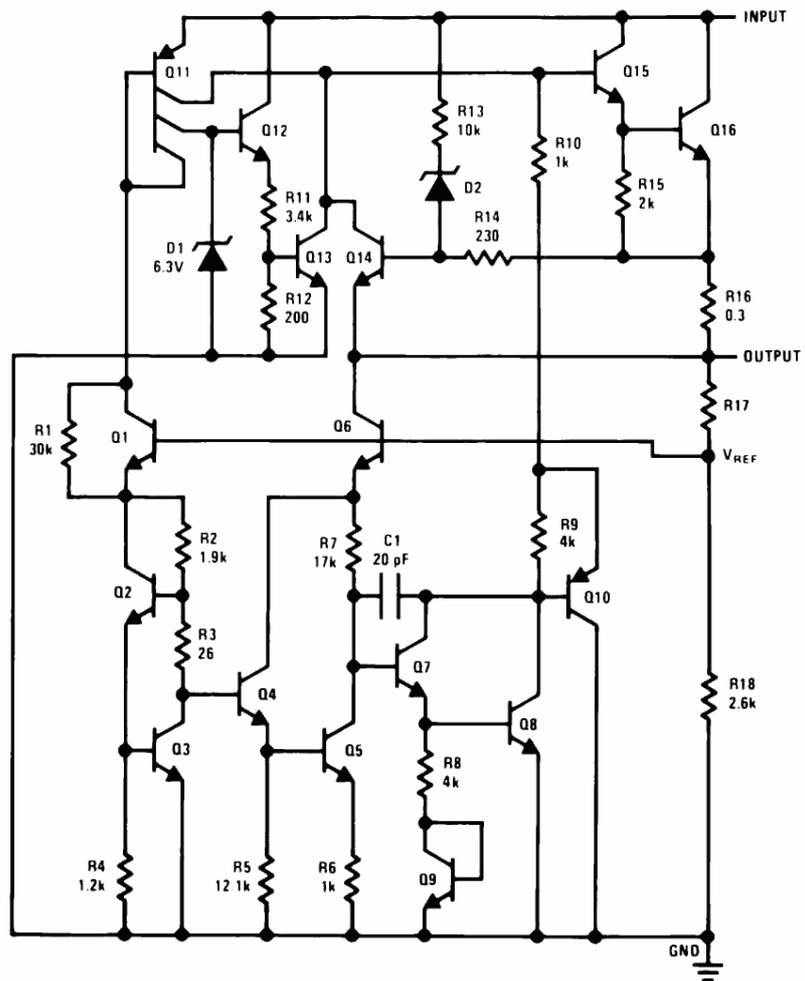
Voltage Range

LM7805C	5V
LM7812C	12V
LM7815C	15V

Connection Diagrams



Schematic



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Absolute Maximum Ratings (Note 3)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage ($V_O = 5V, 12V$ and $15V$)	35V
Internal Power Dissipation (Note 1)	Internally Limited
Operating Temperature Range (T_A)	0 to +70

Maximum Junction Temperature (K Package)	150
(T Package)	150
Storage Temperature Range	-65 to +150
Lead Temperature (Soldering, 10 sec.)	
TO-3 Package K	300
TO-220 Package T	230

Electrical Characteristics LM78XX (Note 2)

0 $\leq T_J \leq 125$ unless otherwise noted.

Output Voltage			5V	12V	15V	Units							
Input Voltage (unless otherwise noted)			10V	19V	23V								
Symbol	Parameter	Conditions	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
V_O	Output Voltage	$T_J = 25^\circ C, 5mA \leq I_O \leq 1A$	4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V	
		$P_D \leq 15W, 5mA \leq I_O \leq 1A$	4.75			11.4		12.6	14.25			V	
		$V_{MIN} \leq V_{IN} \leq V_{MAX}$	5.25			(14.5 $\leq V_{IN} \leq 27$)			15.76			V	
V_O	Line Regulation	$V_O = 500mA$	$T_J = 25^\circ C$	3	50	4	120		4	150		mV	
			V_{IN}	(7 $\leq V_{IN} \leq 25$)			(14.5 $\leq V_{IN} \leq 30$)			(17.5 $\leq V_{IN} \leq 30$)		V	
		$0 \leq T_J \leq +125^\circ C$	V_{IN}		50		120		150		150		mV
			V_{IN}	(8 $\leq V_{IN} \leq 20$)			(15 $\leq V_{IN} \leq 27$)			(18.5 $\leq V_{IN} \leq 30$)			V
$I_O \leq 1A$	$T_J = 25^\circ C$		50		150		150		150		mV		
	V_{IN}	(7.5 $\leq V_{IN} \leq 20$)			(14.6 $\leq V_{IN} \leq 27$)			(17.7 $\leq V_{IN} \leq 30$)			V		
$0 \leq T_J \leq 125^\circ C$	V_{IN}		25		60		75		75		mV		
	V_{IN}	(8 $\leq V_{IN} \leq 12$)			(16 $\leq V_{IN} \leq 22$)			(20 $\leq V_{IN} \leq 26$)			V		
V_O	Load Regulation	$T_J = 25^\circ C$	$5mA \leq I_O \leq 1.5A$	10	50	12	120		12	150		mV	
			$250mA \leq I_O \leq 750A$		25		60		75			mV	
		$5mA \leq I_O \leq 1A, 0 \leq T_J \leq +125^\circ C$		50		120		150			mV		
I_Q	Quiescent Current	$I_O \leq 1A$	$T_J = 25^\circ C$		8		8		8		8	mA	
			$0 \leq T_J \leq 125^\circ C$		8.5		8.5		8.5		8.5	mA	
I_Q	Quiescent Current Change	$5mA \leq I_O \leq 1A$			0.5		0.5		0.5		0.5	mA	
			$T_J = 25^\circ C, I_O \leq 1A$		1.0		1.0		1.0		1.0	mA	
			$V_{MIN} \leq V_{IN} \leq V_{MAX}$	(7.5 $\leq V_{IN} \leq 20$)			(14.8 $\leq V_{IN} \leq 27$)			(17.9 $\leq V_{IN} \leq 30$)		1.0	V
		$I_O \leq 500mA, 0 \leq T_J \leq +125^\circ C$		1.0		1.0		1.0		1.0	mA		
		$V_{MIN} \leq V_{IN} \leq V_{MAX}$	(7 $\leq V_{IN} \leq 25$)			(14.5 $\leq V_{IN} \leq 30$)			(17.5 $\leq V_{IN} \leq 30$)		V		
V_N	Output Noise Voltage	$T_A = 25^\circ C, 10Hz \leq f \leq 100kHz$		40		75		90				μV	
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	$f = 120Hz$	$I_O \leq 1A, T_J = 25^\circ C$	62	80	55	72		54	70		dB	
			Or $I_O \leq 500mA$	62		55		54				dB	
		$0 \leq T_J \leq 125^\circ C$			(8 $\leq V_{IN} \leq 18$)			(15 $\leq V_{IN} \leq 25$)			(18.5 $\leq V_{IN} \leq 28.5$)		V
		$V_{MIN} \leq V_{IN} \leq V_{MAX}$											
R_O	Dropout Voltage	$T_J = 25^\circ C, I_{OUT} = 1A$		2.0		2.0		2.0		2.0		V	
			Output Resistance	$F = 1kHz$	8		18		19				$m\Omega$
	Short-circuit current	$T_J = 25^\circ C$		2.1		1.5		1.2				A	
	Peak Output Current	$T_J = 25^\circ C$		2.4		2.4		2.4				A	
	Average TC of V_{OUT}	$0 \leq T_J \leq 125^\circ C, I_O = 5mA$		0.6		1.5		1.8				mV/	
V_{IN}	Input Voltage Required To Maintain Line Regulation	$T_J = 25^\circ C, I_O \leq 1A$		7.5		14.6		17.7				V	

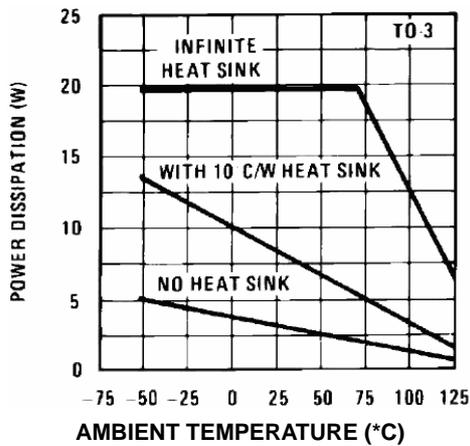
Note 1: Thermal resistance of the TO-3 package (K, KC) is typically 4 °W junction to case and 35 °W case to ambient. Thermal resistance of the TO-220 package (T) is typically 4 °W junction to case and 50 °W case to ambient.

Note 2: All characteristics are measured with capacitor across the input of 0.22µF, and a capacitor across the output of 0.1µF. All characteristics except noise voltage and ripple rejection ratio are measured using pulse techniques ($t_W \leq 10\text{ms}$, duty cycle $\leq 5\%$). Output voltage changes due to changes in internal temperature must be taken into account separately.

Note 3: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. For guaranteed specifications and the test conditions, see Electrical Characteristics.

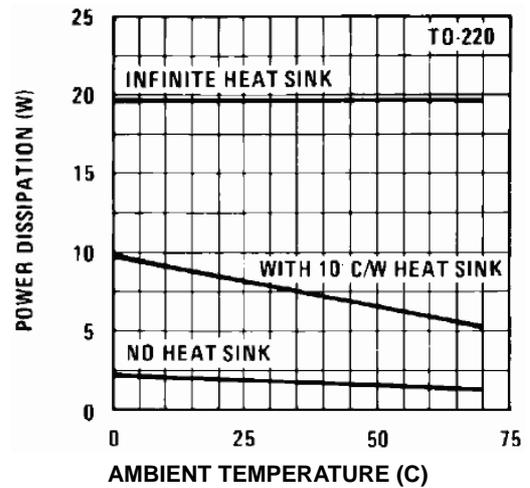
Typical Performance Characteristics

Maximum Average Power Dissipation



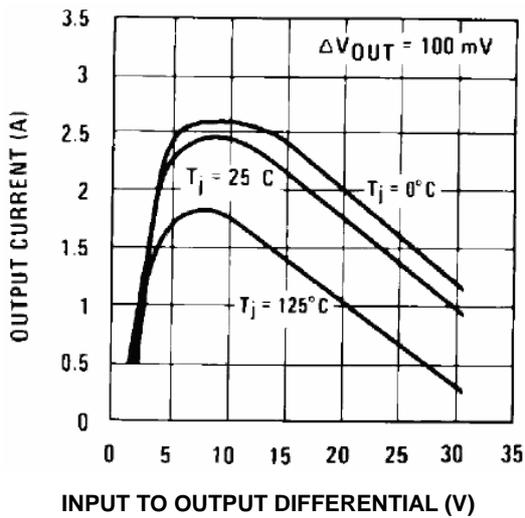
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Maximum Average Power Dissipation



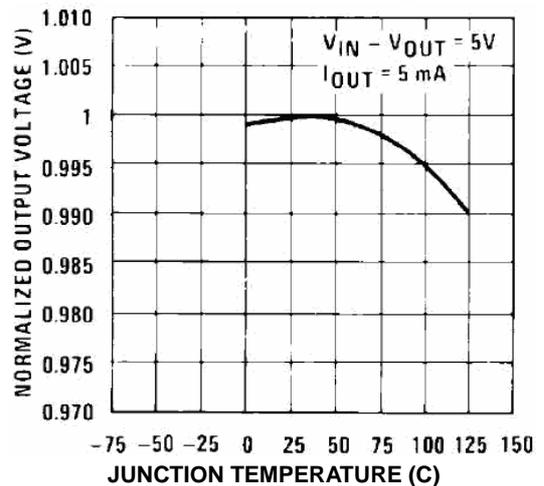
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Peak Output Current



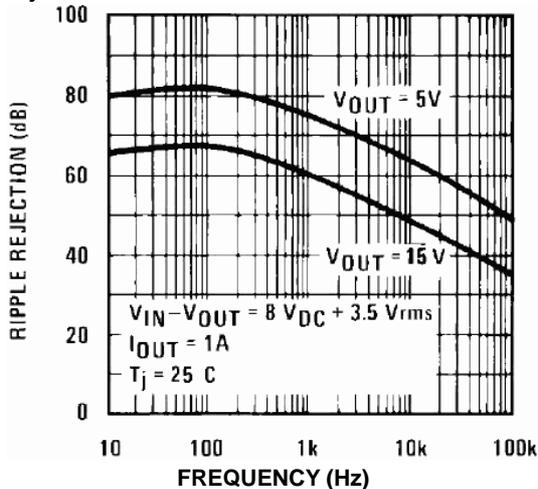
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Output Voltage (Normalized to 1V at TJ=25)



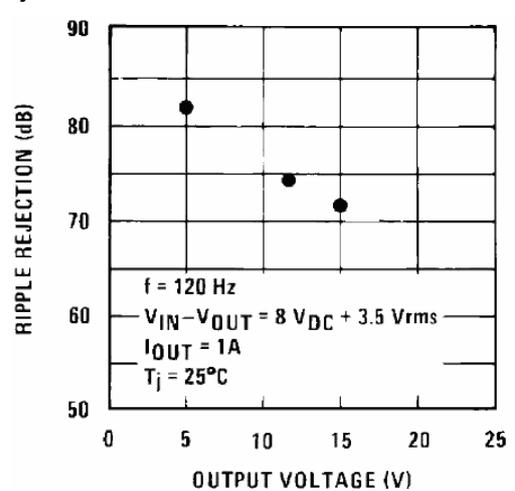
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Ripple Rejection



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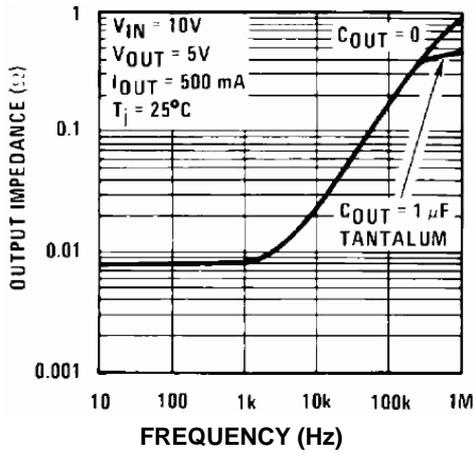
Ripple Rejection



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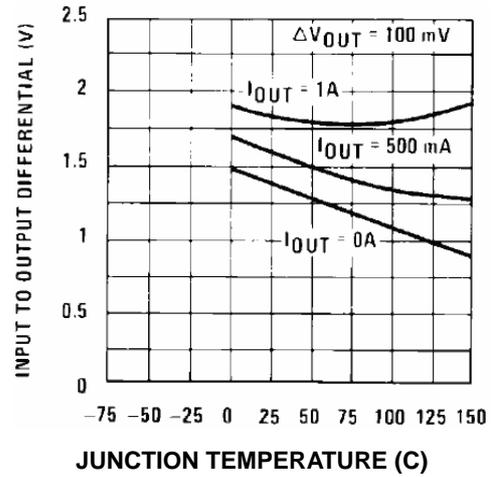
Typical Performance Characteristics (Continued)

Output Impedance



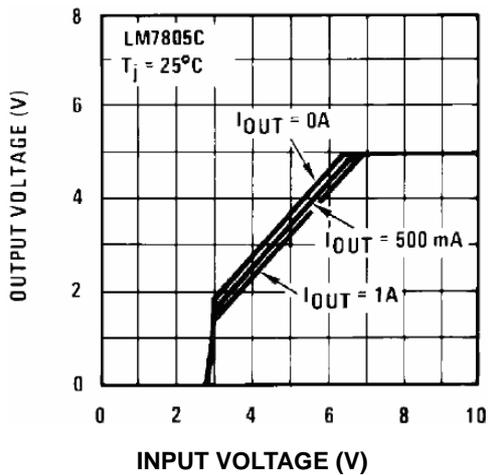
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Dropout Voltage



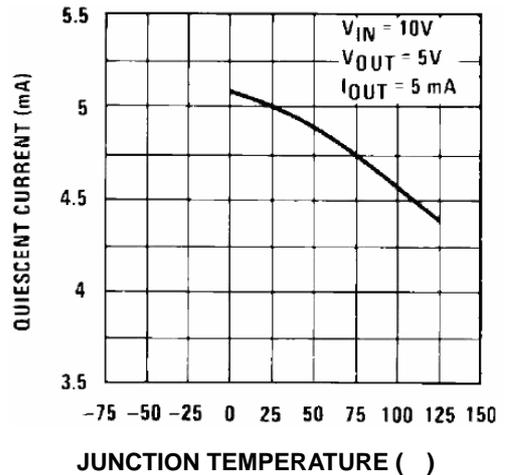
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Dropout Characteristics



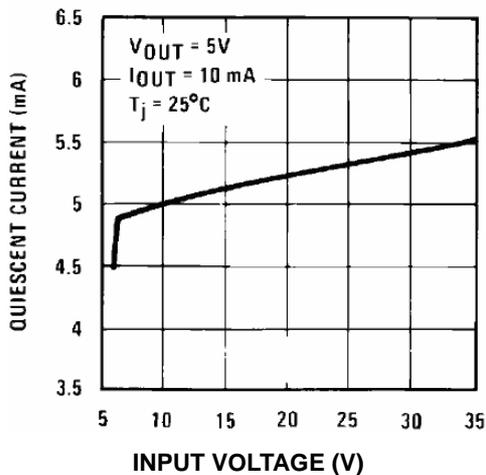
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Quiescent Current

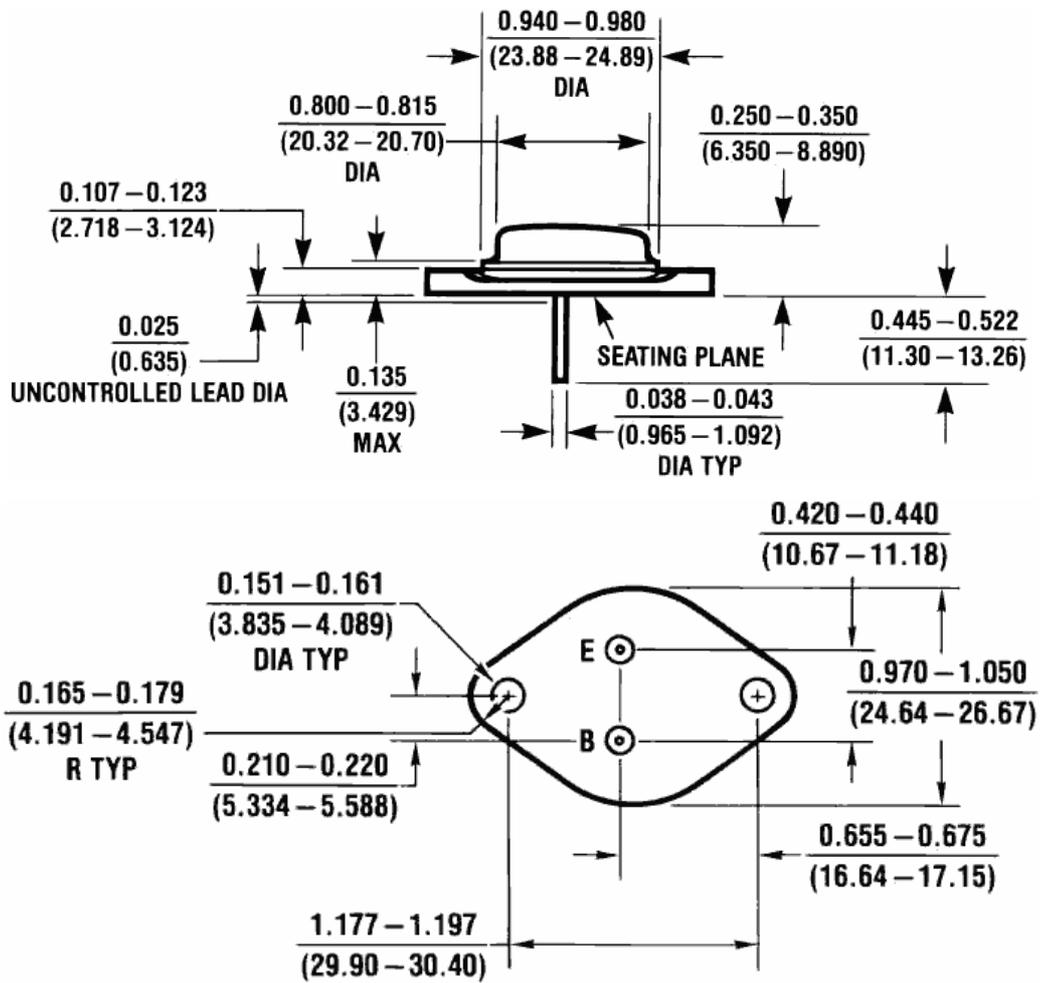


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Quiescent Current



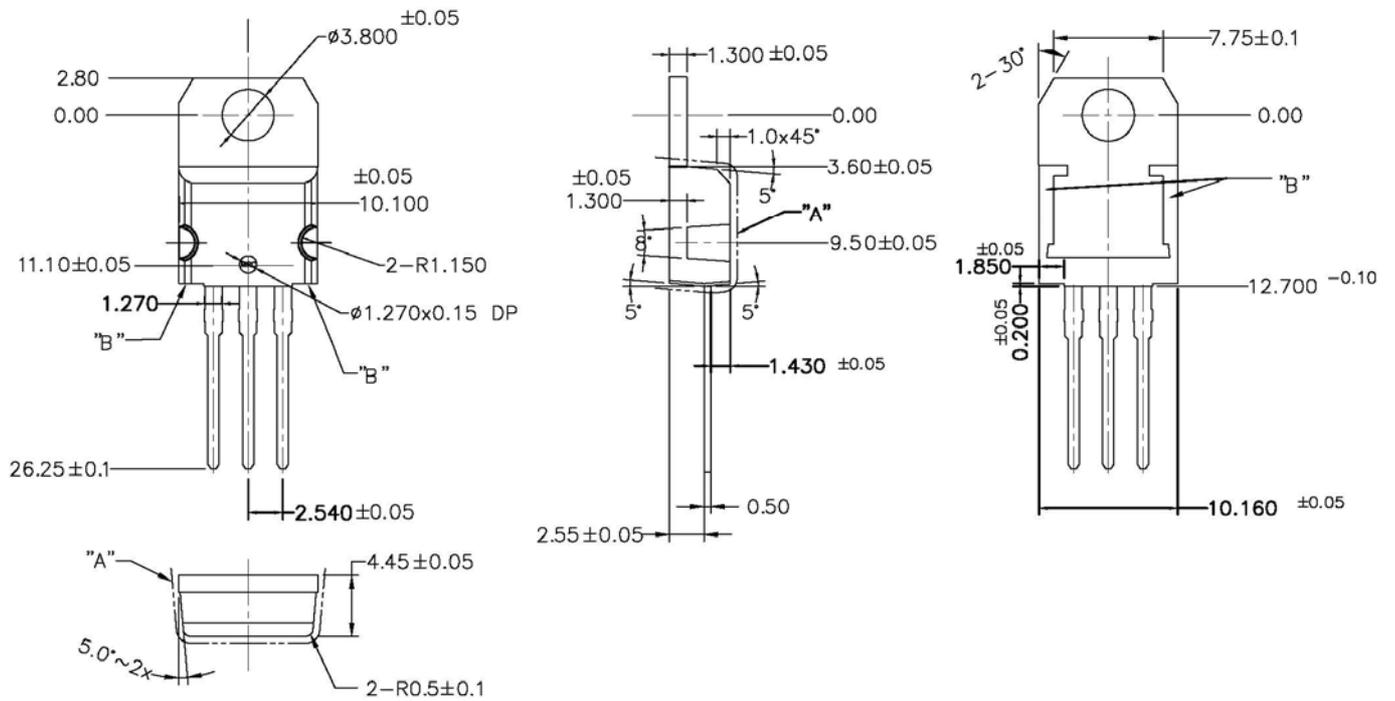
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Typical Performance Characteristics inches (millimeters) unless otherwise noted


KC02A (REV C)

Aluminum Metal Can Package (KC)
 Order Number LM7805CK, LM7812CK or LM7815CK

Physical Dimensions inches (millimeters) unless otherwise noted



TO-220 Package (T)
Order Number LM7805CT, LM7812CT or LM7815CT