

## LM78XX Series Voltage Regulators

 Check for Samples: [LM7805C](#), [LM7812C](#), [LM7815C](#)

### 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

### 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.

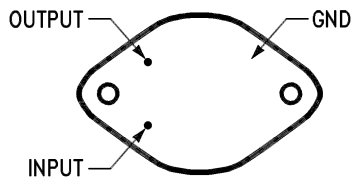
Considerable effort was expended to make the LM78XX series of regulators easy to use and minimize the number of external components. It is not necessary to bypass the output, although this does improve transient response. Input bypassing is needed only if the regulator is located far from the filter 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.

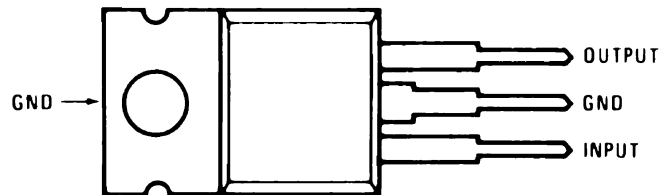
### VOLTAGE RANGE

- LM7805C: 5V
- LM7812C: 12V
- LM7815C: 15V

### Connection Diagrams



**Figure 1. Metal Can Package  
TO-3  
Aluminum  
Bottom View**



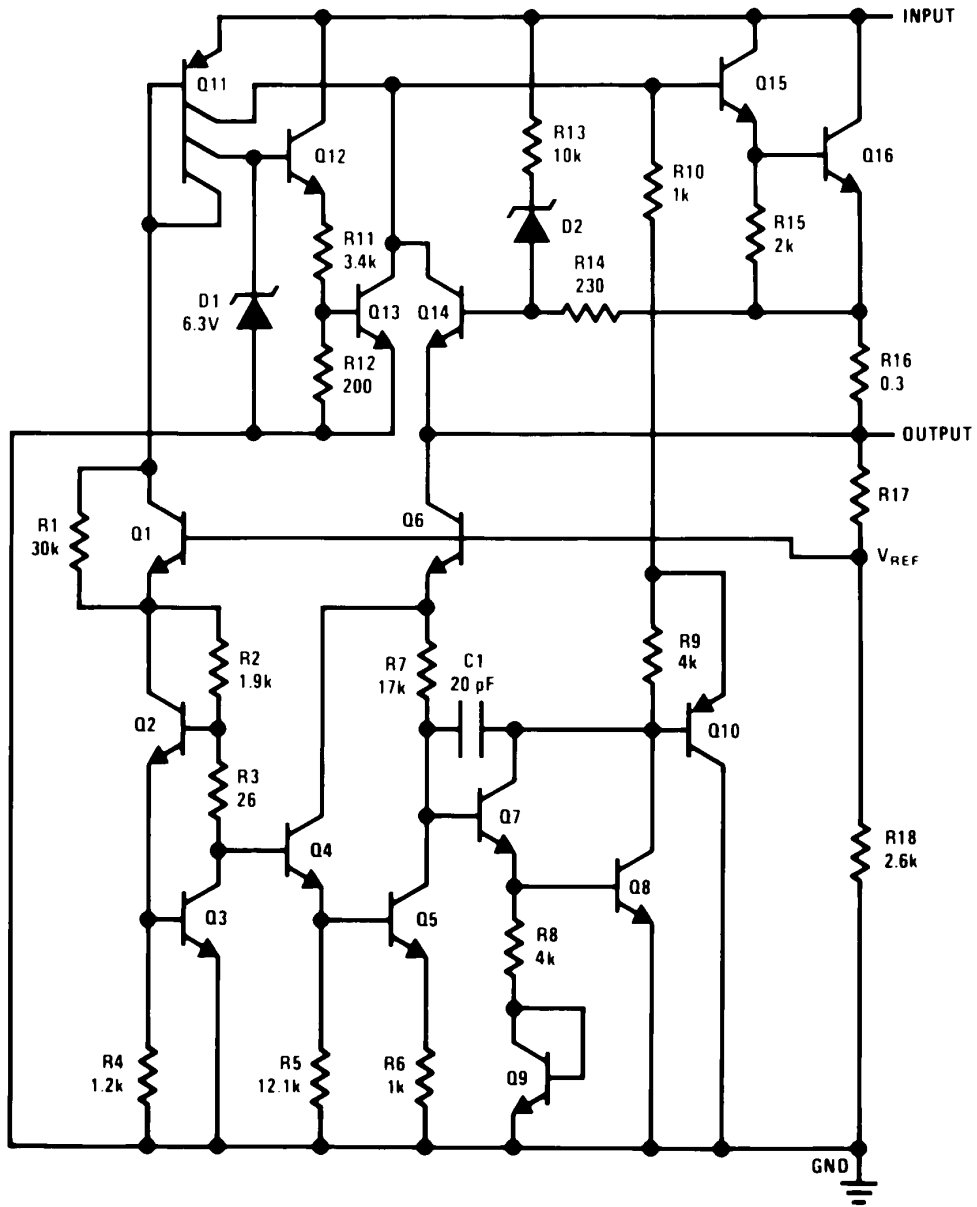
**Figure 2. Plastic Package  
TO-220 (NDE)  
Top View  
See Package Number NDE0003B**



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**SCHEMATIC DIAGRAM**





These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

**ABSOLUTE MAXIMUM RATINGS<sup>(1)(2)</sup>**

Input Voltage ( $V_O = 5V, 12V$ and $15V$ )		35V
Internal Power Dissipation <sup>(3)</sup>		Internally Limited
Operating Temperature Range ( $T_A$ )		0°C to +70°C
Maximum Junction Temperature	(TO-3 Package)	150°C
	(NDE Package)	150°C
Storage Temperature Range		-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	TO-3 Package	300°C
	TO-220 Package NDE	230°C

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. For ensured specifications and the test conditions, see Electrical Characteristics.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
- (3) Thermal resistance of the TO-3 package is typically 4°C/W junction to case and 35°C/W case to ambient. Thermal resistance of the TO-220 package (NDE) is typically 4°C/W junction to case and 50°C/W case to ambient.

**ELECTRICAL CHARACTERISTICS LM78XXC<sup>(1)</sup>**

0°C ≤  $T_J$  ≤ 125°C 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	$T_J = 25^\circ\text{C}, 5\text{ mA} \leq I_O \leq 1\text{ A}$	4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V	
		$P_D \leq 15\text{ W}, 5\text{ mA} \leq I_O \leq 1\text{ A}$	4.75		5.25	11.4		12.6	14.2		15.7	V	
		$V_{\text{MIN}} \leq V_{\text{IN}} \leq V_{\text{MAX}}$	(7.5 ≤ $V_{\text{IN}}$ ≤ 20)			(14.5 ≤ $V_{\text{IN}}$ ≤ 27)			(17.5 ≤ $V_{\text{IN}}$ ≤ 30)			V	
$\Delta V_O$	Line Regulation	$I_O = 500\text{ mA}$	$T_J = 25^\circ\text{C}$	3 50		4 120		4 150		mV			
			$\Delta V_{\text{IN}}$	(7 ≤ $V_{\text{IN}}$ ≤ 25)		14.5 ≤ $V_{\text{IN}}$ ≤ 30)		(17.5 ≤ $V_{\text{IN}}$ ≤ 30)		V			
			$0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$	50		120		150		mV			
		$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$	50		120		150		mV			
			$\Delta V_{\text{IN}}$	(7.5 ≤ $V_{\text{IN}}$ ≤ 20)		(14.6 ≤ $V_{\text{IN}}$ ≤ 27)		(17.7 ≤ $V_{\text{IN}}$ ≤ 30)		V			
			$0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$	25		60		75		mV			
$\Delta V_O$	Load Regulation	$T_J = 25^\circ\text{C}$	$5\text{ mA} \leq I_O \leq 1.5\text{ A}$		10	50		12	120		12	150	mV
			$250\text{ mA} \leq I_O \leq 750\text{ mA}$			25			60			75	mV
		$5\text{ mA} \leq I_O \leq 1\text{ A}, 0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$			50			120			150	mV	
$I_Q$	Quiescent Current	$I_O \leq 1\text{ A}$	$T_J = 25^\circ\text{C}$			8			8			8	mA
			$0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$			8.5			8.5			8.5	mA
$\Delta I_Q$	Quiescent Current Change	$5\text{ mA} \leq I_O \leq 1\text{ A}$				0.5			0.5			0.5	mA
		$T_J = 25^\circ\text{C}, I_O \leq 1\text{ A}$	1.0		1.0		1.0		mA				
		$V_{\text{MIN}} \leq V_{\text{IN}} \leq V_{\text{MAX}}$	(7.5 ≤ $V_{\text{IN}}$ ≤ 20)		(14.8 ≤ $V_{\text{IN}}$ ≤ 27)		(17.9 ≤ $V_{\text{IN}}$ ≤ 30)		V				
		$I_O \leq 500\text{ mA}, 0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$	1.0		1.0		1.0		mA				
		$V_{\text{MIN}} \leq V_{\text{IN}} \leq V_{\text{MAX}}$	(7 ≤ $V_{\text{IN}}$ ≤ 25)		(14.5 ≤ $V_{\text{IN}}$ ≤ 30)		(17.5 ≤ $V_{\text{IN}}$ ≤ 30)		V				

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

**ELECTRICAL CHARACTERISTICS LM78XXC<sup>(1)</sup> (continued)**0°C ≤ T<sub>J</sub> ≤ 125°C 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 <sub>N</sub>	Output Noise Voltage	T <sub>A</sub> = 25°C, 10 Hz ≤ f ≤ 100 kHz		40			75			90		μV
ΔV <sub>IN</sub> /ΔV <sub>OUT</sub>	Ripple Rejection	f = 120 Hz I <sub>O</sub> ≤ 1A, T <sub>J</sub> = 25°C or I <sub>O</sub> ≤ 500 mA 0°C ≤ T <sub>J</sub> ≤ +125°C	62	80		55	72		54	70		dB
			62			55			54			dB
		V <sub>MIN</sub> ≤ V <sub>IN</sub> ≤ V <sub>MAX</sub>	(8 ≤ V <sub>IN</sub> ≤ 18)			(15 ≤ V <sub>IN</sub> ≤ 25)			(18.5 ≤ V <sub>IN</sub> ≤ 28.5)			V
R <sub>O</sub>	Dropout Voltage	T <sub>J</sub> = 25°C, I <sub>OUT</sub> = 1A		2.0			2.0			2.0		V
	Output Resistance	f = 1 kHz		8			18			19		mΩ
	Short-Circuit Current	T <sub>J</sub> = 25°C		2.1			1.5			1.2		A
	Peak Output Current	T <sub>J</sub> = 25°C		2.4			2.4			2.4		A
	Average TC of V <sub>OUT</sub>	0°C ≤ T <sub>J</sub> ≤ +125°C, I <sub>O</sub> = 5 mA		0.6			1.5			1.8		mV/°C
V <sub>IN</sub>	Input Voltage Required to Maintain Line Regulation	T <sub>J</sub> = 25°C, I <sub>O</sub> ≤ 1A		7.5		14.6			17.7			V

TYPICAL PERFORMANCE CHARACTERISTICS

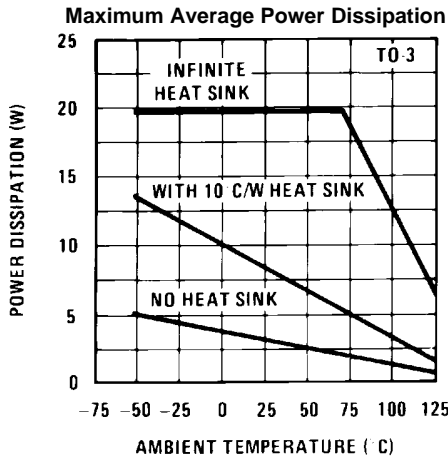


Figure 3.

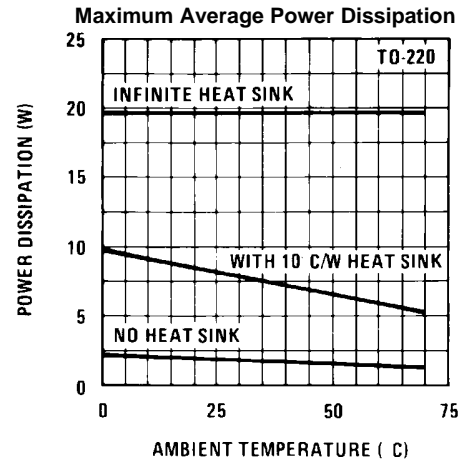


Figure 4.

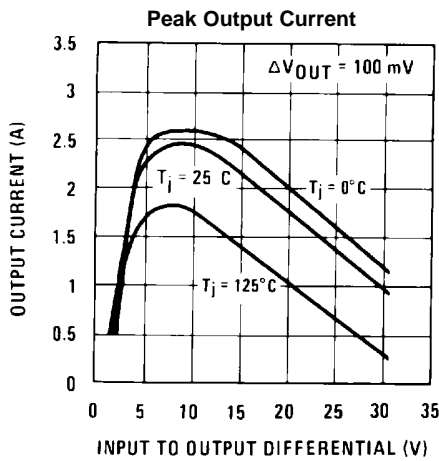


Figure 5.

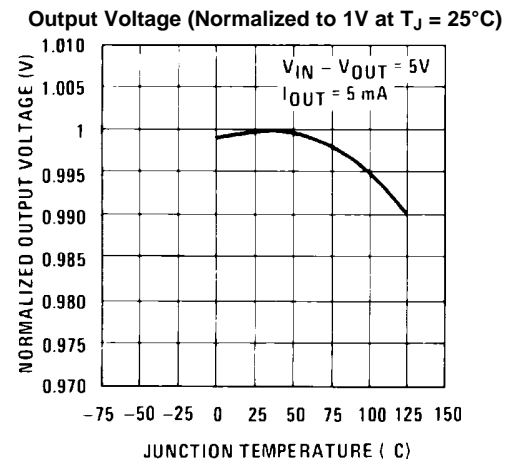


Figure 6.

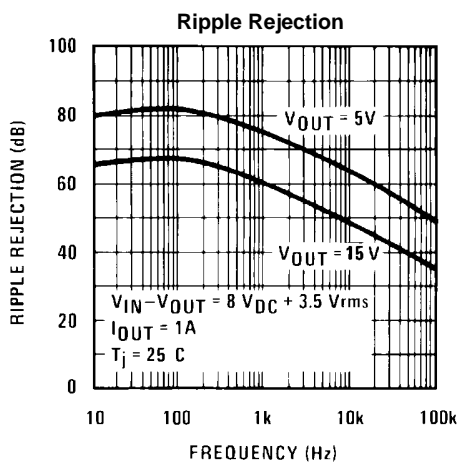


Figure 7.

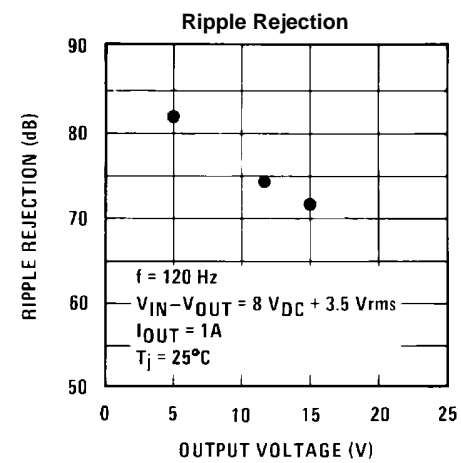
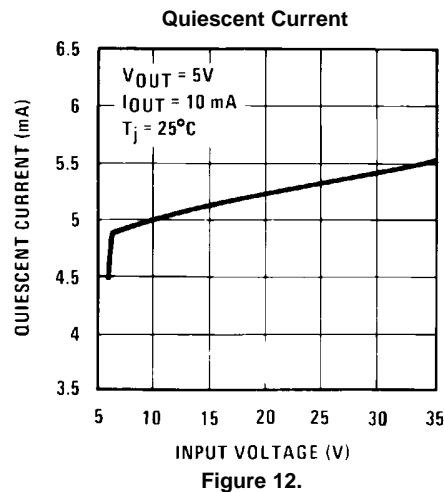
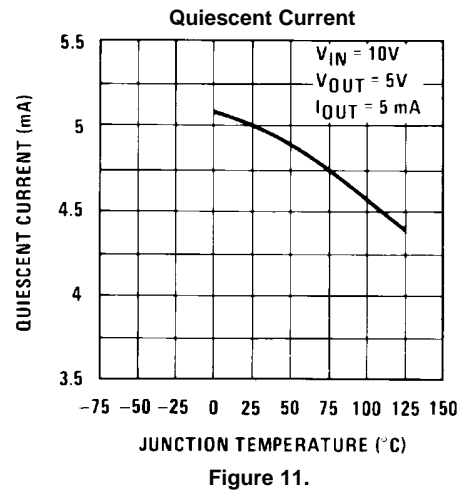
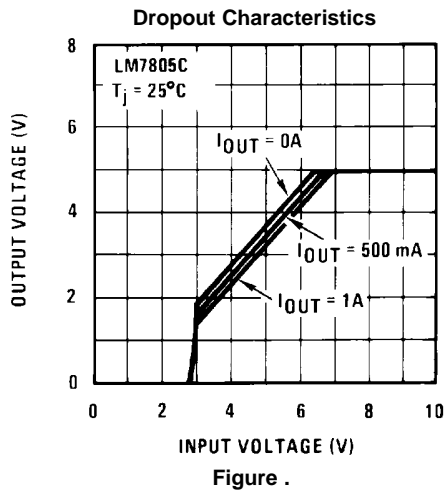
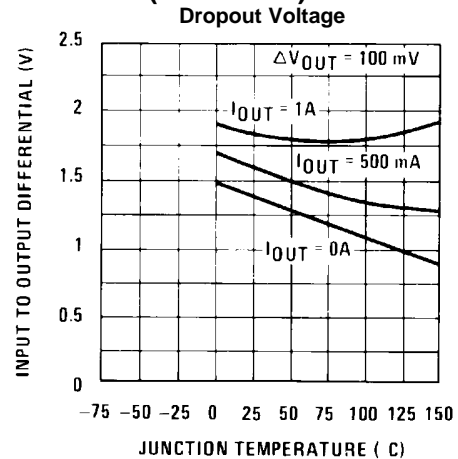
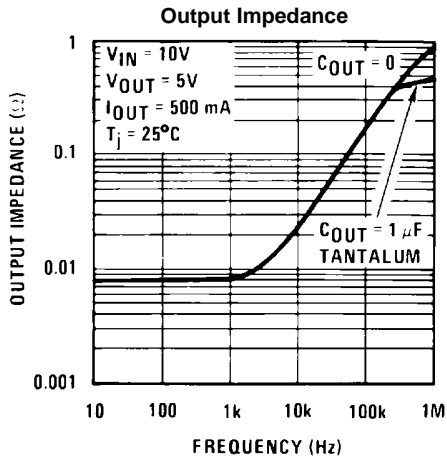


Figure 8.

**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**



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## REVISION HISTORY

<b>Changes from Revision C (April 2013) to Revision D</b>	<b>Page</b>
• Changed layout of National Data Sheet to TI format .....	<a href="#">6</a>

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**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM7805CT	ACTIVE	TO-220	NDE	3	45	TBD	Call TI	Call TI	0 to 70	LM340T5 7805 P+	<a href="#">Samples</a>
LM7805CT/NOPB	ACTIVE	TO-220	NDE	3	45	Pb-Free (RoHS Exempt)	CU SN	Level-1-NA-UNLIM	0 to 70	LM340T5 7805 P+	<a href="#">Samples</a>
LM7815CT	ACTIVE	TO-220	NDE	3	45	TBD	Call TI	Call TI	0 to 70	LM340T15 7815 P+	<a href="#">Samples</a>
LM7815CT/NOPB	ACTIVE	TO-220	NDE	3	45	Green (RoHS & no Sb/Br)	CU SN	Level-1-NA-UNLIM	0 to 70	LM340T15 7815 P+	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

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TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
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