



Features

- +12V Bus Input
- 5-bit Programmable:
1.3V to 3.5V or
4.5V to 7.6V
- High Efficiency
- Differential Remote Sense
- 27-pin SIP Package
- Parallelable with PT7748
17A current booster

Description

The PT7720 series is a +12-V input, 17-A output, high-performance Integrated Switching Regulator (ISR), housed in a 27-pin SIP package. The 17A capability allows easy integration of the latest high-speed, low-voltage microprocessors and bus drivers into +12V power systems.

The output voltage is programmable using a 5-bit code. The output voltage range and code for the PT7721 is compatible with Intel's Pentium® II processor.

The PT7720 series has been designed to work in parallel with one or more of the PT7748 current boosters, allowing the output load current capacity to be increased in increments of 17A.

A differential remote sense is provided to compensate for voltage drop between the ISR to the load. A 1200µF of output capacitance is required for proper operation.

Ordering Information

- PT7721□** = 1.3 to 3.5 Volts
PT7722□ = 4.5 to 7.6 Volts
PT7748□ = 17-A Booster

Pin-Out Information

Pin	Function	Pin	Function
1	VID0	15	GND
2	VID1	16	GND
3	VID2	17	GND
4	VID3	18	GND
5	STBY #	19	GND
6	VID4	20	Vout
7	Vin	21	Vout
8	Vin	22	Vout
9	Vin	23	Vout
10	Vin	24	Vout
11	Vin	25	Vout
12	Sense Gnd	26	Sense Vout
13	GND	27	Sync Out
14	GND		

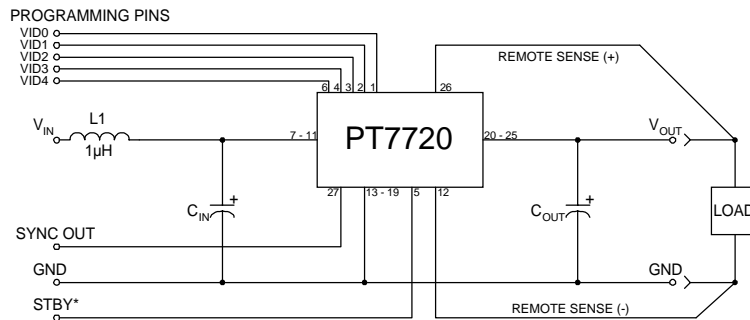
PT Series Suffix (PT1234 x)

Case/Pin Configuration	Order Suffix	Package Code *
Vertical	N	(EJE)
Horizontal	A	(EJF)
SMD	C	(EJG)

* Previously known as package styles 1000/1010. (Reference the applicable package code drawing for the dimensions and PC board layout)

For further information, see application notes.

Standard Application



- C_{in} = Required 560µF electrolytic (See input filter note)
- C_{out} = Required 1200µF electrolytic
- L_1 = Optional 1µH input choke

PT7720 Series

17 A, 12-V Input "Big-Hammer II"
Programmable ISR

Programming Information

				PT7721		PT7722	
VID3	VID2	VID1	VID0	VID4=1 Vout	VID4=0 Vout	VID4=1 Vout	VID4=0 Vout
1	1	1	1	2.0V	1.30V	4.5V	6.1V
1	1	1	0	2.1V	1.35V	4.6V	6.2V
1	1	0	1	2.2V	1.40V	4.7V	6.3V
1	1	0	0	2.3V	1.45V	4.8V	6.4V
1	0	1	1	2.4V	1.50V	4.9V	6.5V
1	0	1	0	2.5V	1.55V	5.0V	6.6V
1	0	0	1	2.6V	1.60V	5.1V	6.7V
1	0	0	0	2.7V	1.65V	5.2V	6.8V
0	1	1	1	2.8V	1.70V	5.3V	6.9V
0	1	1	0	2.9V	1.75V	5.4V	7.0V
0	1	0	1	3.0V	1.80V	5.5V	7.1V
0	1	0	0	3.1V	1.85V	5.6V	7.2V
0	0	1	1	3.2V	1.90V	5.7V	7.3V
0	0	1	0	3.3V	1.95V	5.8V	7.4V
0	0	0	1	3.4V	2.00V	5.9V	7.5V
0	0	0	0	3.5V	2.05V	6.0V	7.6V

Logic 0 = Pin 12 potential (remote sense gnd)

Logic 1 = Open circuit (no pull-up resistors)

VID3 and VID4 may not be changed while the unit is operating.

Specifications (Unless otherwise stated, $T_a = 25^\circ\text{C}$, $V_{in} = 12\text{V}$, $C_{in} = 560\mu\text{F}$, $C_{out} = 1200\mu\text{F}$, and $I_o = I_{o,max}$)

Characteristics	Symbols	Conditions	PT7720 SERIES			Units	
			Min	Typ	Max		
Output Current	I_o	$T_a = +60^\circ\text{C}$, 200 LFM, pkg N, $T_a = +25^\circ\text{C}$, natural convection,	$V_o \leq 5\text{V}$ $V_o \leq 5\text{V}$	0.1 (1) 0.1 (1)	— —	17 (2) 17 (2)	A
Output Power	P_o	$T_a = +60^\circ\text{C}$, 200 LFM, pkg N, $T_a = +25^\circ\text{C}$, natural convection,	$V_o \geq 5\text{V}$ $V_o \geq 5\text{V}$	— —	— —	85 85	W
Input Voltage Range	V_{in}	$0.1\text{A} \leq I_o \leq 17\text{A}$	—	11.0	—	14.0	V
Output Voltage Tolerance	ΔV_o	$0^\circ\text{C} \leq T_a \leq +60^\circ\text{C}$	(PT7721) (PT7722)	$V_o - 0.03$ —	— ± 1	$V_o + 0.03$ ± 2	V % V_o
Line Regulation	Reg_{line}	$11\text{V} \leq V_{in} \leq 14\text{V}$ (with remote sense)	—	—	± 5	± 10	mV
Load Regulation	Reg_{load}	$0.1 \leq I_o \leq 17\text{A}$ (with remote sense)	—	—	± 5	± 10	mV
V_o Ripple/Noise	V_n	—	(PT7721) (PT7722)	— —	50 100	— —	mVpp
Transient Response with $C_{out} = 1200\mu\text{F}$	t_{tr} V_{os}	I_o step between 7.5A and 15A V_o over/undershoot	— —	— —	100 200	— —	μSec mV
Efficiency	η	$I_o = 10\text{A}$	$V_o = 5.0\text{V}$ $V_o = 3.3\text{V}$ $V_o = 2.5\text{V}$ $V_o = 1.5\text{V}$	— — — —	90 88 85 78	— — — —	%
Switching Frequency	f_s	$11\text{V} \leq V_{in} \leq 14\text{V}$ $0.1\text{A} \leq I_o \leq 17\text{A}$	—	300	350	400	kHz
Operating Temperature Range	T_a	—	—	0	—	+85 (3)	$^\circ\text{C}$
Storage Temperature	T_s	—	—	-40	—	+125	$^\circ\text{C}$
Mechanical Shock	—	Per Mil-STD-883D, Method 2002.3, 1 msec, Half Sine, mounted to a fixture	—	—	TBD	—	G's
Mechanical Vibration	—	Per Mil-STD-883D, Method 2007.2, 20-2000 Hz, Soldered in a PC board	—	—	TBD	—	G's
Weight	—	—	Vertical Horizontal	— —	53 66	— —	grams

Notes: (1) The ISR will operate down to no load with reduced specifications. Please note that this product is not short-circuit protected.

(2) The PT7720 series can be easily paralleled with one or more of the PT7748 Current Boosters to provide increased output current in increments of 17A.

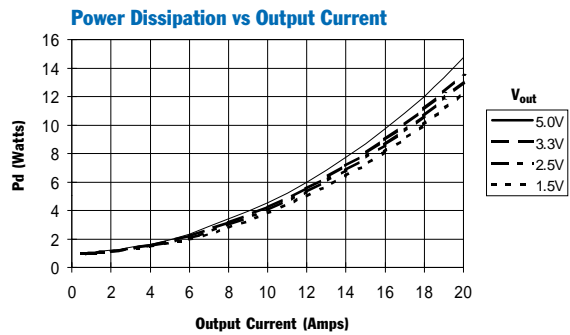
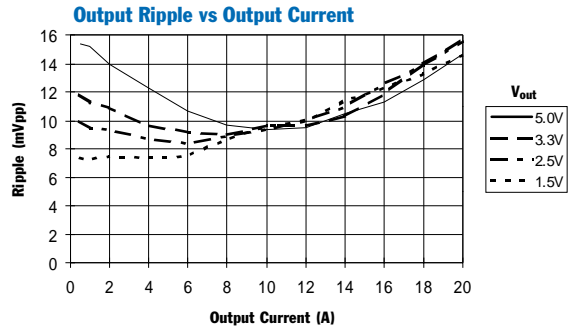
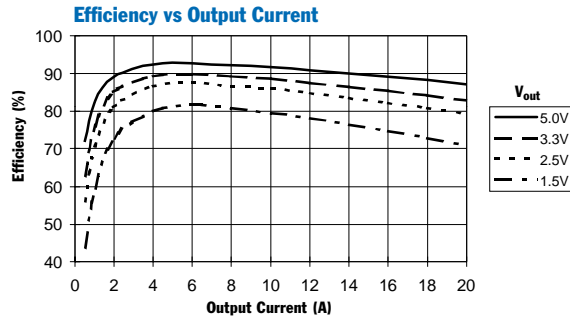
(3) See Safe Operating Area curves or contact the factory for the appropriate derating.

Output Capacitors: The PT7720 series requires a minimum output capacitance of 1200 μF for proper operation. Do not use Oscon type capacitors. The maximum allowable output capacitance is $(57,000 \div V_{out})\mu\text{F}$, or 15,000 μF , whichever is less.

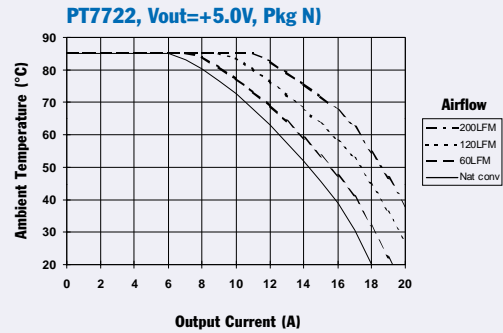
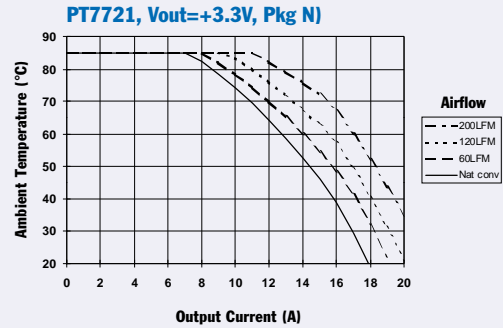
Input Filter: An input inductor is optional for most applications. The input inductor must be sized to handle 7ADC with a typical value of 1 μH . The input capacitance must be rated for a minimum of 4 Arms of ripple current when operated at maximum output current and maximum output voltage. Contact an applications specialist for input capacitor selection for applications at other output voltages and output currents.

17 A, 12-V Input "Big-Hammer II"
Programmable ISR

PT7721/PT7722 @ $V_{in} = 12V$ (See Note A)



Safe Operating Area, $V_{in} = +12V$ (See Note B)



Note A: Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the Converter.
Note B: SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures

Using the PT7748 17-A Current Booster with the PT7720 Series Programmable ISRs

The PT7748 is a 17-A “Current Booster” module for the PT7720 series of regulators. The booster is controlled directly by the regulator, and effectively adds a parallel output stage. This allows the system to run synchronously, providing a low noise solution. Up to four booster modules can be connected to a single regulator. Each booster increases the available output current by 17A. Combinations of a regulator and booster modules can supply power for virtually any multi-processor application.

A current booster is not a stand-alone product, and can only operate with a regulator. It is housed in the same package as its compatible regulator, and shares the same mechanical outline. Except for an increase in output current, the overall performance of a PT7720 regulator/booster combination is identical to that of a stand-alone regulator. Refer to the appropriate data sheet for the performance specifications.

Notes:

1. Each booster requires the same amount of input and output capacitance as recommended for a stand-alone regulator. See the Standard Application schematic and

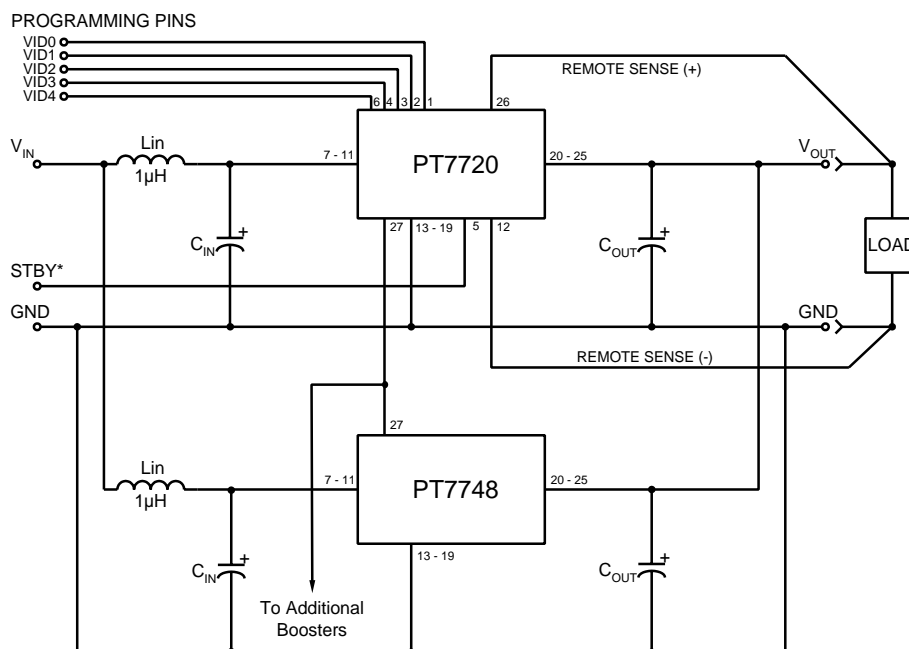
the respective input/output filter notes in the PT7720 product data sheet.

2. The 1- μ H filter choke located at the input of each regulator and booster module (L_{in}) is optional for most applications. If specified, each inductor must be sized to handle 7ADC at full output load.
3. The pin-out of the current booster modules include a number pins identified, “No Connect” (see Table 1). These pins are not connected internally to the module but must be soldered to a pad to preserve the unit’s mechanical integrity.
4. A similar PCB footprint and trace layout between the regulator and each booster will facilitate current sharing between all modules.

Table 1-1; PT7748 Pin-Out Information

Pin	Function	Pin	Function	Pin	Function
1	No Connect	10	V_{in}	19	GND
2	No Connect	11	V_{in}	20	V_{out}
3	No Connect	12	No Connect	21	V_{out}
4	No Connect	13	GND	22	V_{out}
5	No Connect	14	GND	23	V_{out}
6	No Connect	15	GND	24	V_{out}
7	V_{in}	16	GND	25	V_{out}
8	V_{in}	17	GND	26	No Connect
9	V_{in}	18	GND	27	Sync In

Figure 1-1; Current Booster Application Schematic



Pin-Coded Output Voltage Adjustment on the “Big Hammer II” Series ISRs

Power Trends PT7720 series ISRs incorporate pin-coded voltage control to adjust the output voltage. The control pins are identified VID0 - VID4 (pins 1, 2, 3, 4, & 6) respectively. When the control pins are left open-circuit, the ISR will regulate at its factory trimmed output voltage. Each pin is internally connected to a precision resistor, which when grounded changes the output voltage by a set amount. By selectively grounding VID0-VID4, the output voltage of each ISR in the PT7720 series ISRs can be programmed in incremental steps over its specified output voltage range. The output voltage ranges offered by these regulators provide a convenient method of voltage selection for many applications. In addition, the program code and output voltage range of the PT7721 model is compatible with the voltage ID specification defined by Intel Corporation for voltage regulator modules (VRMs) used to power Pentium® II microprocessors. Refer to Figure 2-1 below for the connection schematic, and the PT7720 Data Sheet for the appropriate programming code information.

Notes:

1. The programming convention is as follows:-
 - Logic 0: Connect to pin12 (Remote Sense Ground).
 - Logic 1: Open circuit/open drain (See notes 2, & 4)
2. Do not connect pull-up resistors to the voltage programming pins.
3. To minimize output voltage error, always use pin 12 (Sense Ground) as the logic “0” reference. While the regular

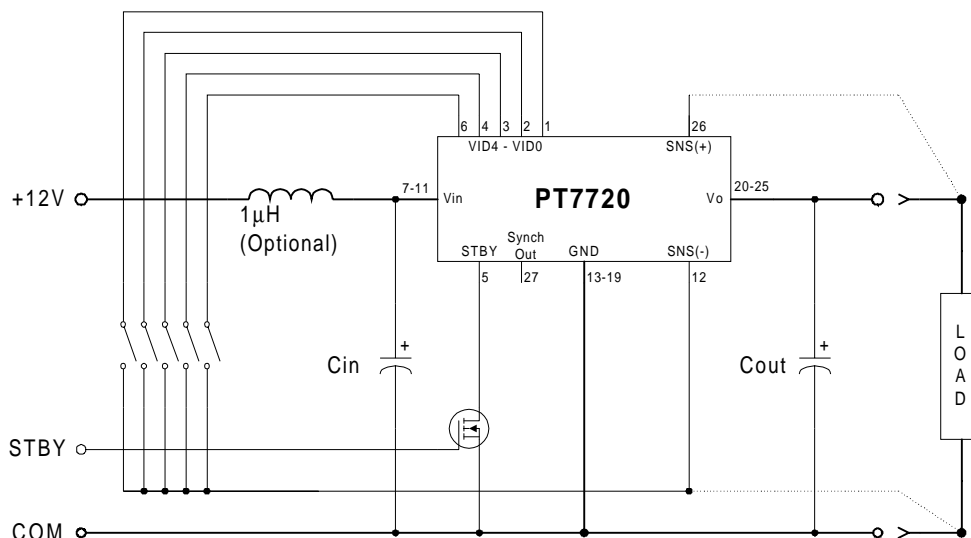
ground (pins 13-19) can also be used for programming, doing so will degrade the load regulation of the product.

4. If active devices are used to ground the voltage control pins, low-level open drain MOSFET devices should be used over bipolar transistors. The inherent $V_{ce(sat)}$ in bipolar devices introduces errors in the device’s internal divider network. Discrete transistors such as the BSS138, 2N7002, or the IRLML2402 are examples of appropriate devices.

Active Voltage Programming:

Special precautions should be taken when making changes to the voltage control program code while the unit is powered. It is highly recommended that the ISR be either powered down or held in standby. Changes made to the program code while V_{out} is enabled induces high current transients through the device. This is the result of the electrolytic output capacitors being either charged or discharged to the new output voltage set-point. The transient current can be minimized by making only incremental changes to the binary code, i.e. one LSB at a time. A minimum of 100 μ s settling time between each program state is also recommended. Making non-incremental changes to VID3 and VID4 with the output enabled is discouraged. If they are changed, the transients induced can overstress the device resulting in a permanent drop in efficiency. If the use of active devices prevents the program code being asserted prior to power-up, pull pin 5 (STBY) to the device GND during the period that the input voltage is applied to V_{in} . Releasing pin 5 will then allow the device output to execute a soft-start power-up to the programmed voltage.

Figure 2-1



Using the Standby Function on the PT7720 “Big Hammer II” Programmable ISRs

For applications requiring output voltage On/Off control, the PT7720 “Big Hammer” ISRs incorporate a standby function. This feature may be used for power-up/shut-down sequencing, and wherever there is a requirement for the output status of the module to be controlled by external circuitry.

The standby function is provided by the *STBY** control, pin 5. If pin 5 is left open-circuit the regulator operates normally, providing a regulated output whenever a valid supply voltage is applied to V_{in} (pins 7-11) with respect to GND (pins 13-19). Connecting pin 5 to ground¹ will set the regulator output to zero volts². This places the regulator in standby mode, and reduces the input current to typically 30mA (50mA max). If a ground signal is applied to pin 5 prior to power-up, the regulator output will be held at zero volts during the period that input power is applied.

The standby input must be controlled with an open-collector (or open-drain) discrete transistor (See Figure 3-1). Table 3-1 gives the threshold requirements.

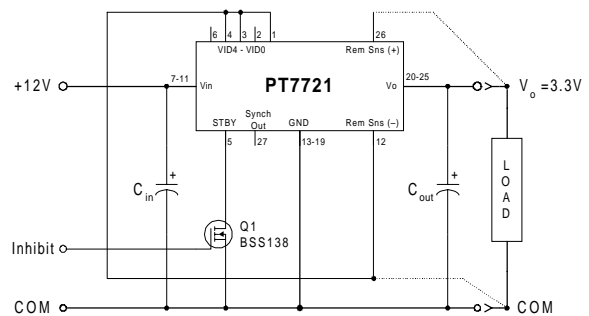
Table 3-1 Inhibit Control Threshold¹

Parameter	Min	Max
Disable (V_{IL})	-0.1V	0.3V

Notes:

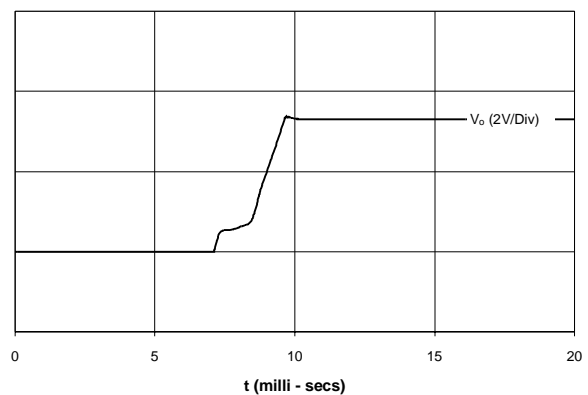
1. The Standby input on the PT7720 regulator series must be controlled using an open-collector (or open-drain) discrete transistor. *Do Not* use a pull-up resistor. The control input has an open-circuit voltage of about 1.5Vdc. To set the regulator output to zero, the control pin must be “pulled” to less than 0.3Vdc with a low-level 0.1mA sink to ground.
2. When placed in the standby mode, the regulator output discharges the output capacitance with a low impedance to ground. If an external voltage is applied to the output, it will sink current and possibly over-stress the part.
3. The turn-off time of Q_1 , or rise time of the standby input is not critical on the PT7720 series. Turning Q_1 off slowly, over periods up to 100ms, will not affect regulator operation. However, a slow turn-off time will increase both the initial delay and rise-time of the output voltage.

Figure 3-1



Turn-On Time: Turning Q_1 in Figure 3-1 off, removes the low-voltage signal at pin 5 and enables the output. Following a brief delay of 5-15ms, the output voltage of the PT7720 series regulators rise to full regulation within 20ms³. Figure 3-2 shows the typical output voltage waveform of a PT7721, following the prompt turn-off of Q_1 at time $t=0$ secs. The output voltage in Figure 3-1 is set to 3.3V by connecting VID0 (pin 1), VID2 (pin 3), and VID3 (pin 4) to the Sense Gnd (pin 12)*. The waveform in Figure 3-2 was measured with a 12-V input source voltage, and 15-A resistive load.

Figure 3-2



* Consult the data sheet for details on other VID codes.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
PT7722N	OBSOLETE	SIP MODULE	EJE	27		TBD	Call TI	Call TI	

(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.

OBSOLETE: 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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

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.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com