

Description

The PT7709 is a next generation "Big Hammer", high-performance Integrated Switching Regulator (ISR), which is made available in Power Trends' aluminum 27-pin SIP package. The PT7709 improves on the popular PT7705 with 20A of output current and short circuit protection.

The PT7709 is suitable for existing 5V system designs that require power for the latest high-speed, low-

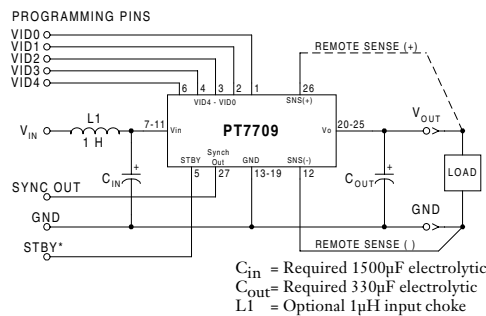
voltage μ Ps, and bus drivers.

The PT7709 output is programmable from 1.3V to 3.5V with a 5-bit input, which is compatible with the Intel Pentium® Processor. A differential remote sense is also provided to compensate for voltage drop between the ISR and load.

Only 330 μ F of output capacitance are required for proper operation.

Pin-Out Information

Standard Application



Pin Function

Pin	Function
1	VID0
2	VID1
3	VID2
4	VID3
5	STBY* - Stand-by
6	VID4
7	V_{in}
8	V_{in}
9	V_{in}

For STBY* pin:
 open = output enabled
 ground = output disabled.

Pin Function

Pin	Function
10	V_{in}
11	V_{in}
12	Remote Sense Gnd (*)
13	GND
14	GND
15	GND
16	GND
17	GND
18	GND

Pin Function

Pin	Function
19	GND
20	V_{out}
21	V_{out}
22	V_{out}
23	V_{out}
24	V_{out}
25	V_{out}
26	Remote Sense V_{out}
27	Sync Out

Specifications

Characteristics (T _a = 25°C unless noted)	Symbols	Conditions	PT7709 SERIES				
			Min	Typ	Max	Units	
Output Current	I _o	T _a = +60°C, 200 LFM, pkg N T _a = +25°C, natural convection	0.1 ⁽¹⁾ 0.1 ⁽¹⁾	— —	20 20	A A	
Input Voltage Range	V _{in}	0.1A ≤ I _o ≤ 20A	4.5	—	5.5	V	
Output Voltage Tolerance	ΔV _o	V _{in} = +5V, I _o = 20A 0°C ≤ T _a ≤ +65°C	V _o -0.03	—	V _o +0.03	V	
Line Regulation	Reg _{line}	4.5V ≤ V _{in} ≤ 5.5V, I _o = 20A	—	±10	—	mV	
Load Regulation	Reg _{load}	V _{in} = +5V, 0.1 ≤ I _o ≤ 20A	—	±10	—	mV	
V _o Ripple/Noise	V _n	V _{in} = +5V, I _o = 20A	—	50	—	mV	
Transient Response with C _{out} = 330μF	t _{tr}	I _o step between 10A and 20A	—	50	—	μSec	
	V _{os}	V _o over/undershoot	—	100	—	mV	
Efficiency	η	V _{in} = +5V, I _o = 10A	V _o = 3.3V	—	92	—	%
			V _o = 2.5V	—	90	—	%
			V _o = 1.8V	—	87	—	%
		V _{in} = +5V, I _o = 20A	V _o = 3.3V	—	90	—	%
			V _o = 2.5V	—	87	—	%
			V _o = 1.8V	—	82	—	%
Switching Frequency	f _o	4.5V ≤ V _{in} ≤ 5.5V 0.1A ≤ I _o ≤ 20A	300	350	400	kHz	
Absolute Maximum Operating Temperature Range	T _a	Over V _{in} and I _o Ranges	-40 ⁽²⁾	—	+85 ⁽³⁾	°C	
Storage Temperature	T _s	—	-40	—	+125	°C	
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, Half Sine, mounted to a fixture	—	500	—	G's	
Mechanical Vibration		Per Mil-STD-883D, Method 2007.2, 20-2000 Hz, Soldered in a PC board	—	10	—	G's	
Weight	—	Vertical/Horizontal	—	31/41	—	grams	

Notes: (1) ISR will operate down to no load with reduced specifications.

(2) For operation below 0°C , C_{in} and C_{out} must have stable characteristics. Use either low ESR tantalum or Oscon® capacitors.

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

(4) If the Remote Sense Ground is not used, pin 12 must be connected to pin 13 for optimum output voltage accuracy.

External Capacitors: The PT7709 requires a minimum output capacitance of 330 μ F for proper operation. The PT7709 also requires an input capacitance of 1500 μ F, which must be rated for a minimum of 1.4Arms of ripple current. For transient or dynamic load applications, additional capacitance may be required. For more information refer to the application note regarding capacitor selection for this product.

Input Filter: An input filter inductor is optional for most applications. The inductor must be sized to handle 20ADC with a typical value of 1 μ H.

Features

- Single-Device: +5V input
- 5-bit Programmable:
1.3V to 3.5V@20A
- High Efficiency
- Differential Remote Sense
- Short-Circuit Protection
- Parallelable with PT7743
20A “Current Booster”

Programming Information

VID3	VID2	VID1	VID0	VID4=1 Vout	VID4=0 Vout
1	1	1	1	2.0V	1.30V
1	1	1	0	2.1V	1.35V
1	1	0	1	2.2V	1.40V
1	1	0	0	2.3V	1.45V
1	0	1	1	2.4V	1.50V
1	0	1	0	2.5V	1.55V
1	0	0	1	2.6V	1.60V
1	0	0	0	2.7V	1.65V
0	1	1	1	2.8V	1.70V
0	1	1	0	2.9V	1.75V
0	1	0	1	3.0V	1.80V
0	1	0	0	3.1V	1.85V
0	0	1	1	3.2V	1.90V
0	0	1	0	3.3V	1.95V
0	0	0	1	3.4V	2.00V
0	0	0	0	3.5V	2.05V

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.

Ordering Information

PT7709□ = 1.3 to 3.5 Volts

(For dimensions and PC board layout,
see Package Styles 800 and 810.)

PT Series Suffix (PT1234X)

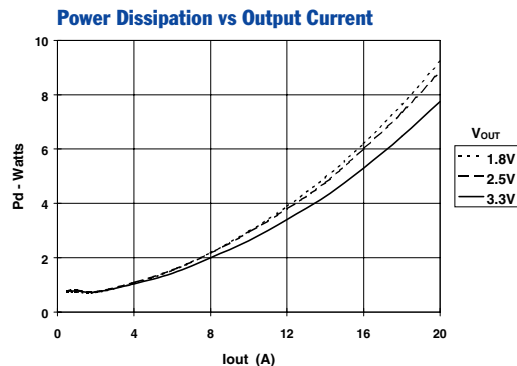
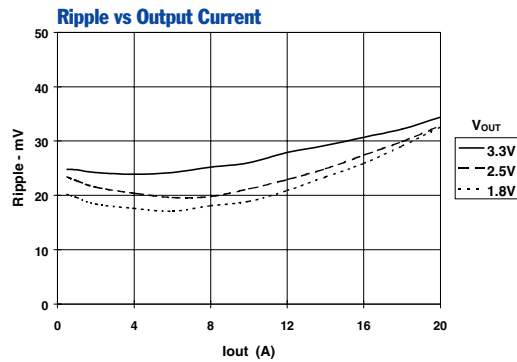
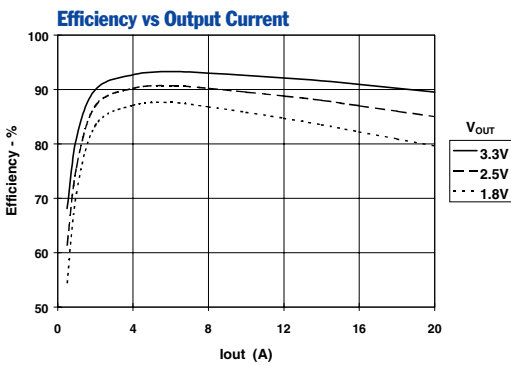
Case/Pin

Configuration

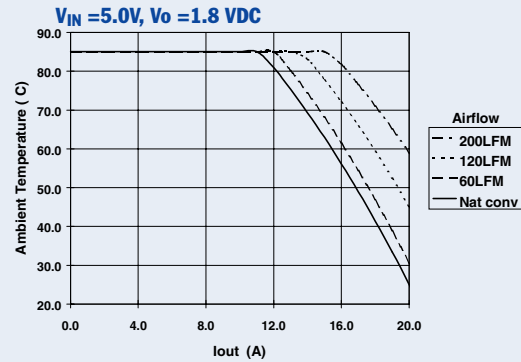
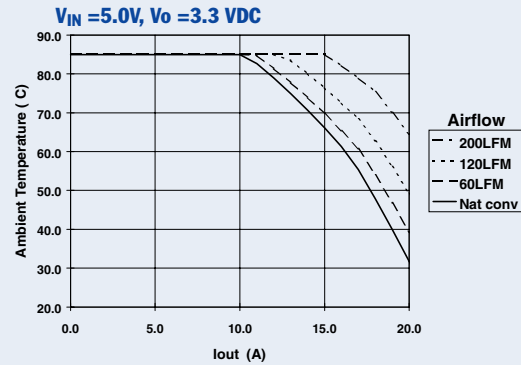
Vertical Through-Hole	N
Horizontal Through-Hole	A
Horizontal Surface Mount	C

TYPICAL CHARACTERISTICS

PT7709 Performance, $V_o = 3.3$ VDC (See Note A)



Safe Operating Area Curves (See Note B)



Note A: All data in the above graphs has been developed from actual products tested at 25°C. The data is considered typical for the ISR

Note B: SOA curves represent operating conditions at which internal components are at or below manufacturer's maximum rated operating temperatures.

Capacitor Recommendations for the PT7708/09 Regulators and PT7742/43 Current Boosters

Input Capacitors

The recommended input capacitance is determined by 1.4 ampere minimum ripple current rating and 1500 μ F minimum capacitance. Capacitors listed below must be rated for a minimum of 2x the input voltage with +5V operation. Ripple current and $\leq 100\text{m}\Omega$ Equivalent Series Resistance (ESR) values are the major considerations along with temperature when selecting the proper capacitor.

Output Capacitors

The minimum required output capacitance is 330 μ F with a maximum ESR less than or equal to 100m Ω . Failure to observe this requirement may lead to regulator instability or oscillation. Electrolytic capacitors have poor ripple performance at frequencies greater than 400kHz, but excellent low frequency transient response. Above the ripple frequency ceramic decoupling capacitors are necessary to improve the transient response and reduce any microprocessor high frequency noise components apparent during higher current excursions. Preferred low ESR type capacitor part numbers are identified in the Table 1 below.

Tantalum Characteristics

Tantalum capacitors with a minimum 10V rating are recommended on the output bus, but only the AVX TPS Series, Sprague 594/595 Series, or Kemet T495/T510 Series. The AVX TPS Series, Sprague Series or Kemet Series capacitors are specified over other types due to their higher surge current, excellent power dissipation and ripple current ratings. As an example, the TAJ Series by AVX is not recommended. This series exhibits considerably higher ESR, reduced power dissipation and lower ripple current capability. The TAJ Series is a less reliable compared to the TPS series when determining power dissipation capability.

Capacitor Table

Table 1 identifies the characteristics of capacitors from a number of vendors with acceptable ESR and ripple current (rms) ratings. The suggested minimum quantities per regulator for both the input and output buses are identified.

This is not an extensive capacitor list. The table below is a selection guide for input and output capacitors. Other capacitor vendors are available with comparable RMS ripple current rating and ESR (Equivalent Series Resistance at 100kHz). These critical parameters are necessary to insure both optimum regulator performance and long capacitor life.

Table 1 Capacitors Characteristic Data

Capacitor Vendor/ Series	Capacitor Characteristics					Quantity		Vendor Number
	Working Voltage	Value(μ F)	(ESR) Equivalent Series Resistance	105°C Maximum Ripple Current(Irms)	Physical Size(mm)	Input Bus	Output Bus	
Panasonic FC Surface Mtg FA	16V 35V	2200 330	0.038 Ω 0.065 Ω	2000mA 1205mA	18x16.5 12.5x16.5	1	1	EEVFC1C222N EEVFC1V331LQ
	10V 16V	680 1800	0.090 Ω 0.032 Ω	755mA 2000mA	10x12.5 18x15	1	1	EEUFA1A681 EEUFA1C182A
United Chemi -Con LFVSeries	25V 16V	330 2200	0.084 Ω 0.038 Ω	825mA 1630mA	10x16 16x20	1	1	LXV25VB331M10X16LL LXV16VB222M16X20LL
	16V	470	0.084 $\Omega/2=0.042\Omega$	825mA x2	10x16		1	LXV16VB471M10X16LL
Nichicon PL Series PM Series	10V 10V	680 1800	0.090 Ω 0.044 Ω	770mA 1420mA	10x15 16x15	1	1	UPL1A681MHH6 UPL1A182MHH6
	25V	330	0.095 Ω	750mA	10x15		1	UPL1E331MPH6
Oscor SS SV	10V 10V	330 330	0.025W/4=0.006 Ω 0.020/4=0.005 Ω	>9800mA >9800mA	10x10.5 10.3x12.6	4 4	N/R (Note)	10SS330M 10SV330M(Surface Mtg)
	10V 10V	330 330	0.100/5=20 Ω 0.060 Ω	3500mA 1826mA	7.3Lx 4.3Wx 4.1H	5 5	1 1	TPSV337M010R0100 TPSV337M010R0060
Sprague Tantalum 595D/594D	10V	330	0.045W/4=0.011 Ω	>4500mA	7.3L x 5.7W x 4.0H	5	1	594D337X0010R2T Surface Mount
	10V	680	0.090 Ω	>1660mA		2	1	595D687X0010R2T
Kemet Tantalum T510/T495 Series	10V	330	0.035 Ω	2000mA	4.3Wx7.3L x4.0H	5	1	510X337M010AS
	10V	220	0.070 $\Omega/2=0.035\Omega$	>2000mA		6	2	T495X227M010AS Surface Mount
Sanyo Poscap TPB	10V	220	0.040 Ω	3000mA	7.2L x 4.3W x 3.1H	6	2	10TPB220M Surface Mount

Note: (N/R) is not recommended for this application, due to extremely low Equivalent Series Resistance (ESR)

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)
PT7709A	NRND	SIP MODULE	EHA	27		TBD	Call TI	Call TI	Samples Not Available
PT7709C	NRND	SIP MODULE	EHC	27		TBD	Call TI	Call TI	Samples Not Available
PT7709N	NRND	SIP MODULE	EHD	27	10	TBD	Call TI	Level-1-215C-UNLIM	Samples Not Available

⁽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.

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