PT7720 Series

17 Amp 12V Input "Big-Hammer II" Programmable ISR

The PT7720 series is a +12V input, 17A 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 μPs and bus drivers into +12V distributed power systems.
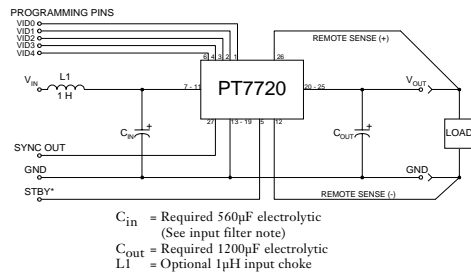
The PT7720 series has been designed to work in parallel with one or more of the PT7748 current boosters for increased I_{out} in increments of 17A.

The output voltage of the PT7721 can be easily programmed from 1.3V to 3.5V with a 5 bit input compatible with Intel's Pentium® II Processor. A differential remote sense is also provided which automatically compensates for any voltage drop from the ISR to the load.

1200μF of output capacitance is required for proper operation.

Standard Application

PROGRAMMING PINS
VID0
VID1
VID2
VID3
VID4

V_{IN} — L1 1 H — PT7720 — V_{OUT} — LOAD

REMOTE SENSE (+)
REMOTE SENSE (-)

SYNC OUT
GND
STBY*

C_{in} = Required 560μF electrolytic (See input filter note)
C_{out} = Required 1200μF electrolytic
L1 = Optional 1μH input choke

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* - Stand-by	19	GND
6	VID4	20	V_{out}
7	V_{in}	21	V_{out}
8	V_{in}	22	V_{out}
9	V_{in}	23	V_{out}
10	V_{in}	24	V_{out}
11	V_{in}	25	V_{out}
12	Remote Sense Gnd	26	Remote Sense V_{out}
13	GND	27	Sync Out
14	GND		

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

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 boosters

Specifications

Characteristics (T$_a$ = 25°C unless noted)	Symbols	Conditions	Min	Typ	Max	Units
				PT7720 SERIES		
			Min	**Typ**	**Max**	**Units**
Output Current	I_o	T_a = +60°C, 200 LFM, pkg N, $V_o \leq$ 5V	0.1 (1)	—	17 (2)	A
		T_a = +25°C, natural convection, $V_o \leq$ 5V	0.1 (1)	—	17 (2)	
Output Power	P_o	T_a = +60°C, 200 LFM, pkg N, $V_o \geq$ 5V	—	—	85	Watts
		T_a = +25°C, natural convection, $V_o \geq$ 5V	—	—	85	
Input Voltage Range V	V_{in}	0.1A $\leq I_o \leq$ 17A	11.0	—	14.0	
Output Voltage Tolerance	ΔV_o	V_{in} = +12V, I_o = 17A (PT7721)	V_o-0.03	—	V_o+0.03	V
		0°C $\leq T_a \leq$ +60°C (PT7722)	—	±1.0%	±2.0%	% V_o
Line Regulation	Reg$_{line}$	11V $\leq V_{in} \leq$ 14V, I_o = 17A (Using remote sense)	—	±5	±10	mV
Load Regulation	Reg$_{load}$	V_{in} = +12V, 0.1 $\leq I_o \leq$ 17A (Using remote sense)	—	±5	±10	mV
V_o Ripple/Noise	V_n	V_{in} = +12V, I_o = 17A (PT7721)	—	50	—	mVpp
		(PT7722)	—	100	—	
Transient Response with C_{out} = 1200μF	t_{tr}	I_o step between 7.5A and 15A	—	100	—	μSec
	V_{os}	V_o over/undershoot	—	200	—	mV
Efficiency	η	V_{in} = +12V, I_o = 10A, V_o = 5.0V	—	90	—	%
		V_o = 3.3V	—	88	—	
		V_o = 2.5V	—	85	—	
		V_o = 1.5V	—	78	—	
Switching Frequency	f_o	11V $\leq V_{in} \leq$ 14V	300	350	400	kHz
		0.1A $\leq I_o \leq$ 17A				
Absolute Maximum Operating Temperature Range	T_a	—	0	—	+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	—	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	—	51/64	—	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 1200μF for proper operation. Do not use Oscon type capacitors. The maximum allowable output capacitance is (57,000 ÷ Vout)μF, or 15,000μF, 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 1μH. The input capacitance must be rated for a minimum of 4.0 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 Amp 12V Input "Big-Hammer II"
Programmable ISR

Programming Information

VID3	VID2	VID1	VID0	PT7721 VID4=1 Vout	PT7721 VID4=0 Vout	PT7722 VID4=1 Vout	PT7722 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.

Ordering Information

PT7721☐ = 1.3 to 3.5 Volts
PT7722☐ = 4.5 to 7.6 Volts

(For dimensions and PC board layout,
see Package Styles 1000 and 1010.)

PT Series Suffix (PT1234X)

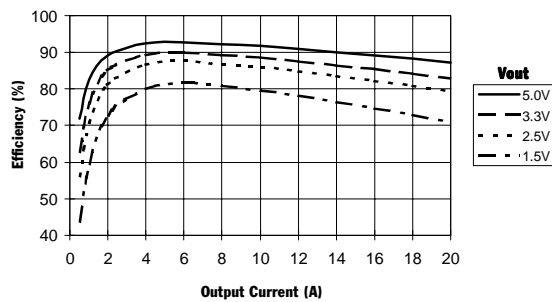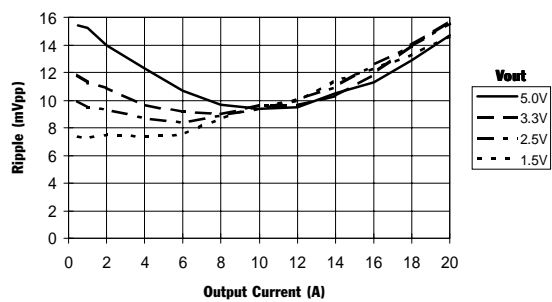| Case/Pin Configuration	
Vertical Through-Hole	**N**
Horizontal Through-Hole	**A**
Horizontal Surface Mount	**C**

T Y P I C A L   C H A R A C T E R I S T I C S

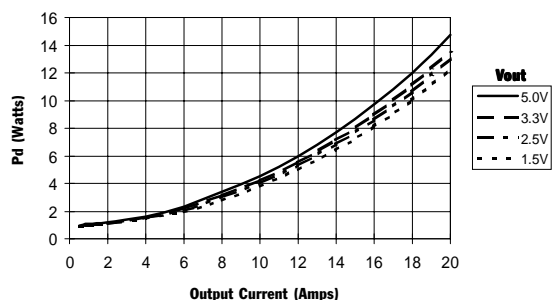## PT7721/PT7722 @V$_{in}$ =12V (See Note A)

Efficiency vs Output Current

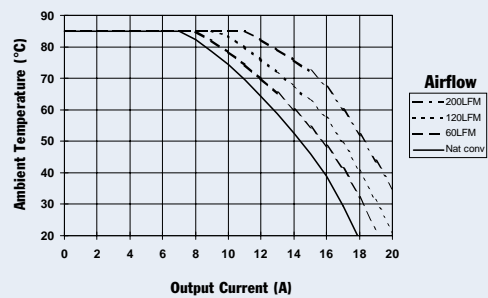### Output Ripple vs Output Current

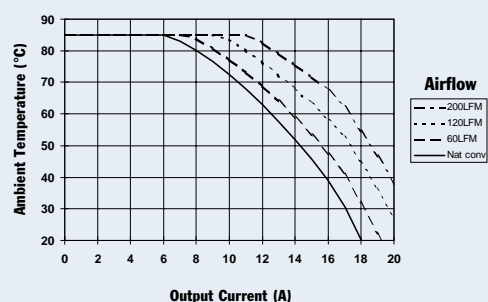### Power Dissipation vs Output Current

Safe Operating Area, Vin=+12V (See Note B)

PT7721, V$_{out}$=+3.3V, Pkg N)

PT7722, V$_{out}$=+5.0V, Pkg N)

Note A: *All characteristic data in the above graphs has been developed from actual products tested at 25°C. This 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.*

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 ouput 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 output 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 output voltage selection for many applications. In addition, the program code and output voltage range of the PT7721 model ISR is compatible with the voltage ID specification defined by Intel Corporation for voltage regulator modules (VRMs) used to power Pentium® microprocessors. Refer to Figure 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 (Remote 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 reglation 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, IRLML2402, or the 74C906 hex open-drain buffer are examples of appropriate devices.

Active Voltage Programming:

Special precautions should be taken when making changes to the voltage control progam 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 setpoint. 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 100µs 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 1
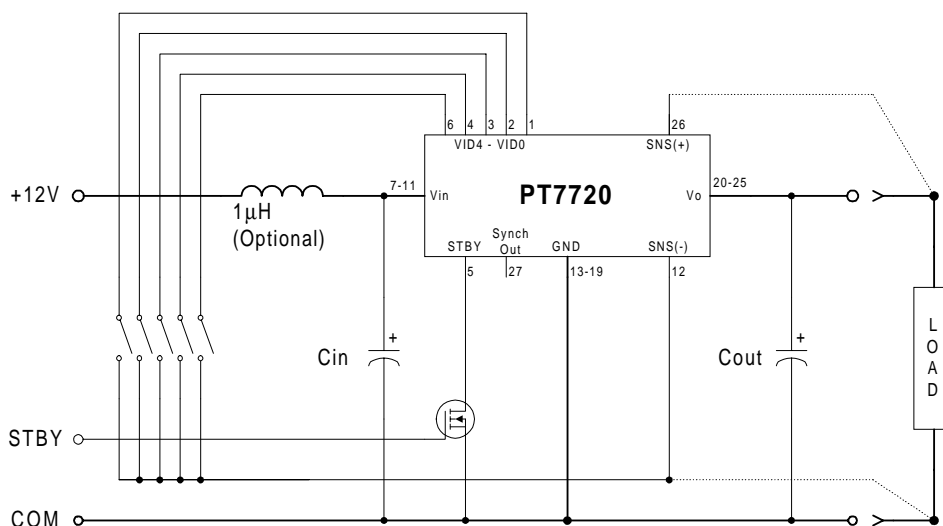
Using the Standby Function on the PT7720 "Big Hammer II" Programmable ISRs

For applications requiring output voltage On/Off control, the PT7720 "Big Hammer" ISRs incorporate a standby function[1] . 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 ground[2] will set the regulator output to zero volts[3] . 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 1). Table 1 gives the threshold requirements.

Table 1 Inhibit Control Threshold [2]

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

Notes:

1. The Standby/Inhibit control logic is similar for all Power Trends' modules, but the flexibility and threshold tolerances will be different. For specific information on this function for other regulator models, consult the applicable application note.
2. 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.
3. 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.
4. 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 1
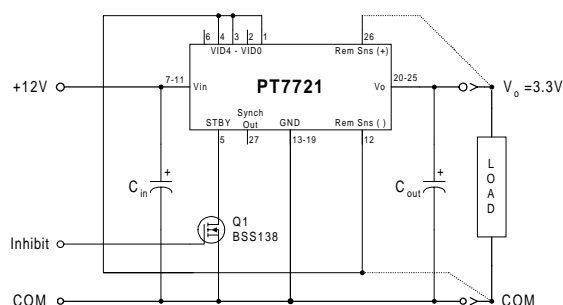
Turn-On Time: Turning Q_1 in Figure 1 off, removes the low-voltage signal at pin 5 and enables the output. Following a brief delay of 5-15ms, the output voltage of the PT7720 series regulators rise to full regulation within 20ms[4] . Figure 2 shows the typical output voltage waveform of a PT7721 following the prompt turn-off of Q_1 at time t =0 secs. The output voltage in Figure 1 is set to 3.3V by connecting VID0 (pin 1), VID2 (pin 3), and VID3 (pin 4) to the Remote Sense Gnd (pin 12)[*]. The waveform in Figure 2 was measured with a 12V input source voltage, and 15A resistive load.

Figure 2
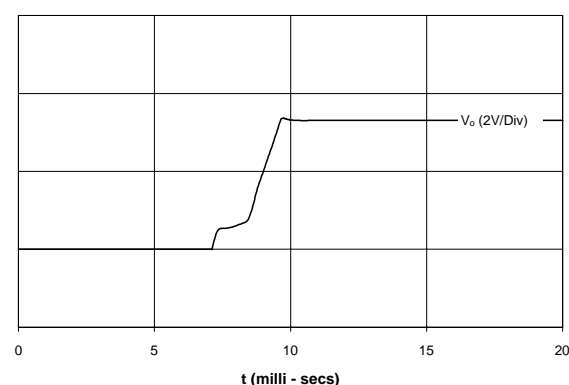
[*] Consult the data sheet for details on other VID codes.

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