

# PT6721—12V

14 Amp Programmable  
Integrated Switching Regulator

**Power Trends Products**  
from Texas Instruments



SLTS101

(Revised 6/30/2000)

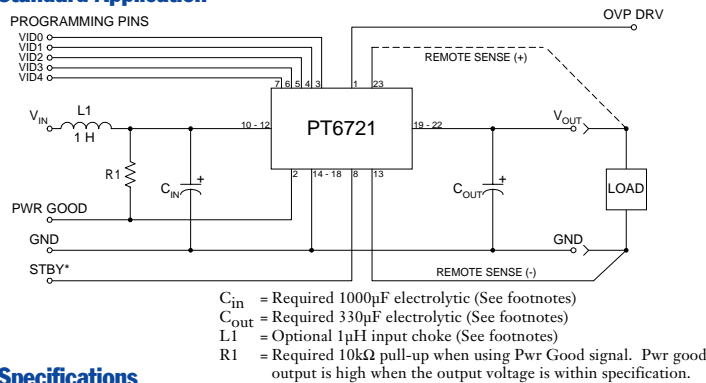
- +12V input
- 5-bit Programmable:  
1.3V to 3.5V@14A
- High Efficiency
- Input Voltage Range:  
10.8V to 13.2V
- Differential Remote Sense
- 23-pin Space Saving Package
- Solderable Copper Case
- Short Circuit Protection
- Over-Voltage Drive
- Power Good Signal

The PT6721 is a new high-performance, 14 Amp Integrated Switching Regulators (ISRs) housed in a unique, 23-pin space-saving package. The PT6721 operates from a standard 12V power bus to provide a high performance low-voltage power source for the industry's latest high-speed, low-voltage  $\mu$ Ps and bus drivers.

The output voltage of the PT6721 can be easily programmed from 1.3V to 3.5V with a 5-bit input compatible with Intel's Pentium® Processor family.

Patent pending on package assembly

## Standard Application



## Specifications

Characteristics ( $T_a = 25^\circ\text{C}$ unless noted)	Symbols	Conditions	PT6721 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	0.1 (1) 0.1 (1)	—	14 14	A
Input Voltage Range	$V_{in}$	$0.1\text{A} \leq I_o \leq 14\text{A}$	10.8	—	13.2	V
Output Voltage Tolerance	$\Delta V_o$	$V_{in} = +12\text{V}$ , $I_o = 14\text{A}$ $-40^\circ\text{C} \leq T_a \leq +85^\circ\text{C}$	$V_o - 0.03$	—	$V_o + 0.03$	V
Short-Circuit Threshold	$I_{sc}$	$V_{in} = +12\text{V}$	—	20	30	A
Line Regulation	$\text{Reg}_{line}$	$10.8\text{V} \leq V_{in} \leq 13.2\text{V}$ , $I_o = 14\text{A}$	—	$\pm 5$	—	mV
Load Regulation	$\text{Reg}_{load}$	$V_{in} = +12\text{V}$ , $0.1 \leq I_o \leq 14\text{A}$	—	$\pm 10$	—	mV
$V_o$ Ripple/Noise	$V_n$	$V_{in} = +12\text{V}$ , $I_o = 14\text{A}$	—	35	—	mV
Transient Response with $C_{out} = 330\mu\text{F}$	$t_{tr}$ $V_{os}$	$I_o$ step between 7A and 14A $V_o$ over/undershoot	—	50 70	—	$\mu\text{Sec}$ mV
Efficiency	$\eta$	$V_{in} = +12\text{V}$ , $I_o = 9\text{A}$	$V_o = 3.3\text{V}$ $V_o = 2.5\text{V}$ $V_o = 1.8\text{V}$ $V_o = 1.5\text{V}$	90 88 83 81	—	%
Switching Frequency	$f_o$	$10.8\text{V} \leq V_{in} \leq 13.2\text{V}$ $0.1\text{A} \leq I_o \leq 14.0\text{A}$	300	350	400	kHz
Absolute Maximum Operating Temperature Range	$T_a$	—	-40 (2)	—	+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	—	500	—	G's
Mechanical Vibration	—	Per Mil-STD-883D, Method 2007.2, 20-2000 Hz, Soldered in a PC board	—	15	—	G's
Weight	—	—	—	26	—	grams

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

(2) For operation below  $0^\circ\text{C}$ ,  $C_{in}$  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 appropriate derating.

(4) If the Remote Sense Ground is not used, pin 13 must be connected to pin 14 for optimum output voltage accuracy.

**External Capacitors:** The PT6721 requires a minimum output capacitance of 330 $\mu\text{F}$ , with a maximum ESR of 50m $\Omega$  @100kHz for proper operation. The maximum allowable output capacitance is 15,000 $\mu\text{F}$ . The input capacitance must be rated for a minimum of 1.6Arms 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 5ADC with a typical value of 1 $\mu\text{H}$ .

# PT6721—12V

## 14 Amp Programmable Integrated Switching Regulator

### Pin-Out Information

Pin	Function	Pin	Function
1	OVP Drive	13	Remote Sense Gnd <sup>(4)</sup>
2	Pwr Good	14	GND
3	VID0	15	GND
4	VID1	16	GND
5	VID2	17	GND
6	VID3	18	GND
7	VID4	19	V <sub>out</sub>
8	STBY#	20	V <sub>out</sub>
9	Do not connect	21	V <sub>out</sub>
10	V <sub>in</sub>	22	V <sub>out</sub>
11	V <sub>in</sub>	23	Remote Sense V <sub>out</sub>
12	V <sub>in</sub>		

<sup>#</sup>For STBY pin:-  
open = output enabled  
ground = output disabled.

### Programming Information

VID3	VID2	VID1	VID0	VID4=1 V <sub>out</sub>	VID4=0 V <sub>out</sub>
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 13 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

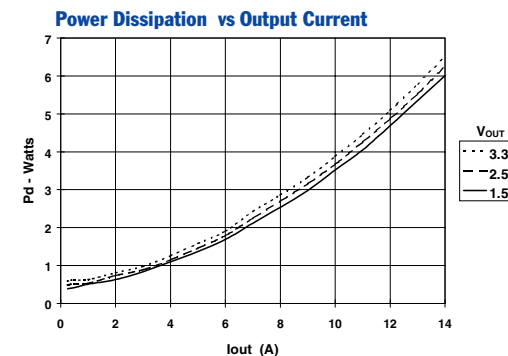
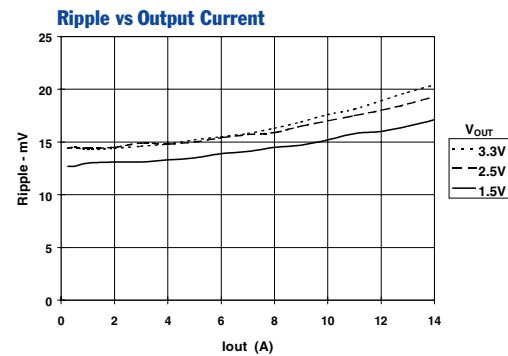
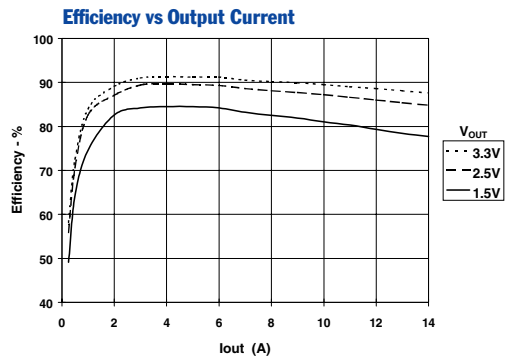
PT6721□ = 1.3 to 3.5 Volts  
(For dimensions and PC board layout, see Package Styles 1300 and 1310.)

### PT Series Suffix (PT1234X)

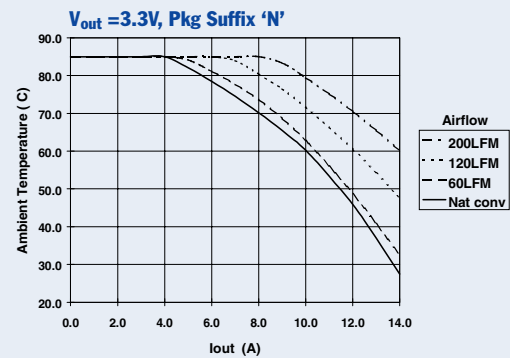
Case/Pin Configuration	
Vertical Through-Hole	N
Horizontal Through-Hole	A
Horizontal Surface Mount	C

## TYPICAL CHARACTERISTICS

### 12.0V Input Voltage (Note A)



### Safe Operating Area Curves (Note B)



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

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

## PT6721/6725 Series

## Capacitor Recommendations for the PT6721 and PT6725 Series Regulators

### Input Capacitors

The recommended input capacitance is determined by 1.6 ampere minimum ripple current rating and 1000µF minimum capacitance. Tantalum capacitors listed below cannot be used on the input bus since they are not rated for 12V operation. Ripple current and 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 330µF with a maximum ESR less than or equal to 50mΩ. 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 are recommended on the output bus but only TPS Series, Sprague 593D/594/595 Series, or Kemet T495/T510 Series. The AVX TPS Series, Sprague Series or Kemet Series tantalum capacitors are recommended over other manufacturer's 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 comparing 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(µF)	(ESR) Equivalent Series Resistance	105°C Maximum Ripple Current(I <sub>rms</sub> )	Physical Size(mm)	Input Bus	Output Bus	
Panasonic FC Series FA Series	35V 25V 25V	680 1000 1000	0.043Ω 0.038Ω 0.038Ω	1655mA 1655mA 1690mA	12.5x20 12.5x20 16x15	2 1 1	1 2 1	EEUFC1V681 EEUFC1E102 EEUFC1E102S
United Chemi-con LFV Series	35V 35V 16V	680 1000 470	0.034Ω 0.038Ω 0.084Ω/2=0.042Ω	1690mA 1630mA 825mA x2	12.5x25 16x20 10x16	2 1 N/R(1)	1 1 2	LXV35VB680M12X25LL LXV35VB102M16X20LL LXV16VB471M10X16LL
Nichicon PL Series PM Series	35V 25V 35V	680 1200 1000	0.036Ω 0.039Ω 0.034Ω	1660mA 1600mA 1770mA	12.5x25 18x15 16x20	2 1 1	1 1 1	UPL1V681MHH UPL1E122MHH6 UPM1V102MHH6
Panasonic FC Series Surface Mtg	35V 25V 35V	1000 1000 470	0.038Ω 0.038Ω 0.0430Ω	2000mA 2000mA 1690mA	18x16.5 18x16.5 16x16.5	1 1 2	1 1 1	EEVFC1V102N EEVFC1E102N EEVFC1V471N
Oscor- SS/SV Series	10V 10V	330 330	0.025Ω 0.020Ω	3500mA 3800mA	10x10.5 10.3x10.3	N/R(1) N/R(1)	1 1	10SS330M( If Output <5V) 10SV330( If Output <5V) Surface Mount(SV)
AVX Tantalum TPS Series	10V 10V	330 330	0.100Ω/2=0.050Ω 0.060Ω/2=0.030Ω	>2500mA >3000mA	7.3L x 5.7W x 4.1H	N/R(1) N/R(1)	2 2	TPSE337M010R0100 TPSV337M010R0060 Surface Mount
Kemet Tantalum T510/T495 Series	10V 10V	330 220	0.033Ω 0.070Ω/2=0.035Ω	1400mA >2000mA	4.3Wx7.3L x4.0H	N/R(1) N/R(1)	1 2	510X337M010AS T495X227M0100AS Surface Mount
Sprague Tantalum 594D Series	10V	330	0.045Ω	2360mA	7.2L x 6W x 4.1H	N/R(1)	1	594D337X0010R2T Surface Mount

**Note:** (N/R) 10V tantalums are not recommend for the input bus.

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