

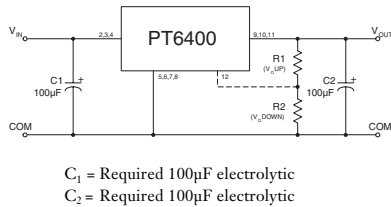
- Single-Device 5V to 3V Power
- 85% Efficiency
- Small SIP Footprint
- Adjustable Output Voltage

The PT6400 is a high performance +5V to +3.3V, 3 Amp, 12-Pin SIP (Single In-line Package) Integrated Switching Regulator (ISR) designed for stand alone (not parallelable) operation. This high-performance ISR

allows easy integration of low-power 3.3V logic IC's into existing 5V systems without redesigning the central power supply. Only two external capacitors are required for proper operation. The output voltage is easily adjustable with one external resistor. The PT6406,7,8 can be used to terminate high-speed data buses such as Futurebus (+2.1V) or the new GTL (+1.2V) logic buses.

Please note that this product does not include short circuit protection.

## Standard Application



## Pin-Out Information

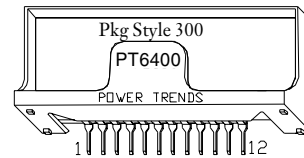
Pin	Function
1	Do not connect
2	V <sub>in</sub>
3	V <sub>in</sub>
4	V <sub>in</sub>
5	GND
6	GND
7	GND
8	GND
9	V <sub>out</sub>
10	V <sub>out</sub>
11	V <sub>out</sub>
12	V <sub>out</sub> -Adjust

## Ordering Information

PT6404□	= +1.5 Volts
PT6405□	= +3.3 Volts
PT6406□	= +1.8 Volts
PT6407□	= +2.1 Volts
PT6408□	= +1.2 Volts
PT6409□	= +2.5 Volts

## PT Series Suffix (PT1234X)

Case/Pin Configuration	
Vertical Through-Hole	<b>P</b>
Horizontal Through-Hole	<b>D</b>
Horizontal Surface Mount	<b>E</b>



Note: Back surface of product is conducting metal.

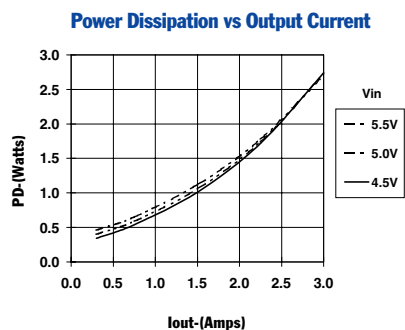
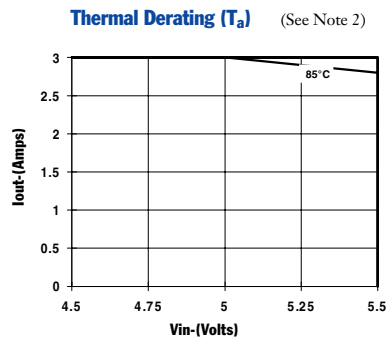
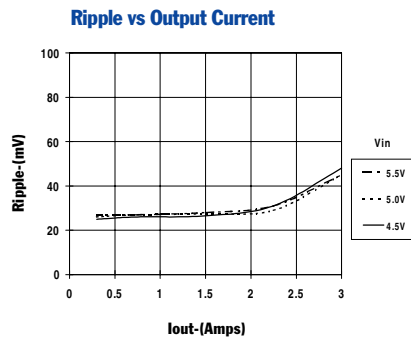
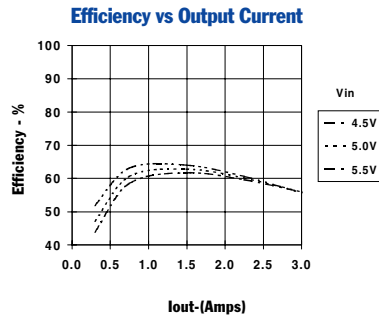
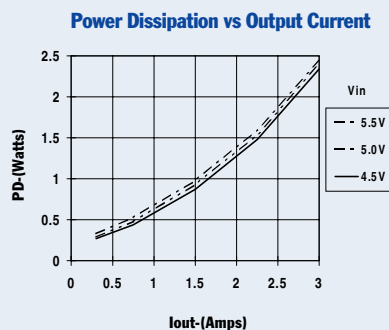
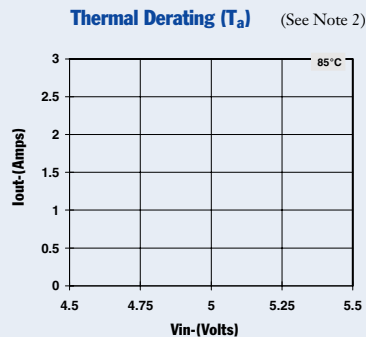
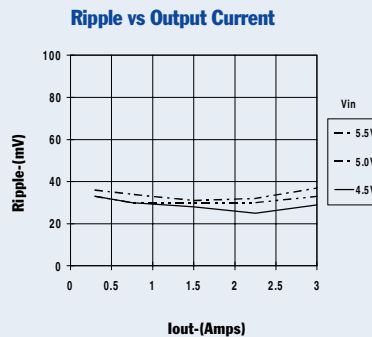
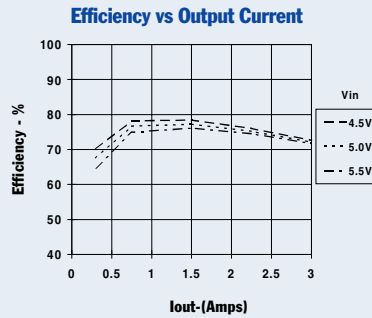
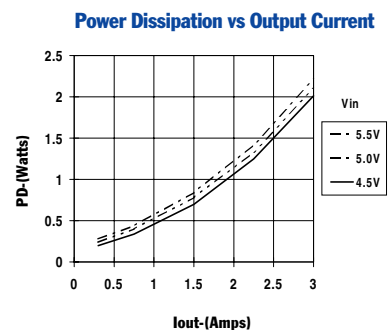
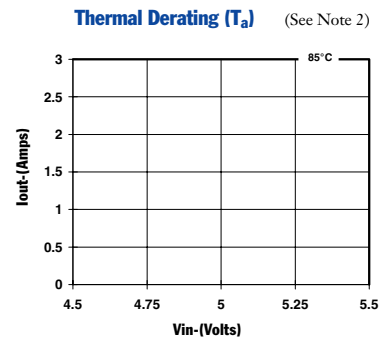
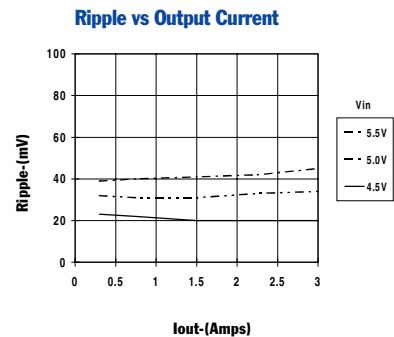
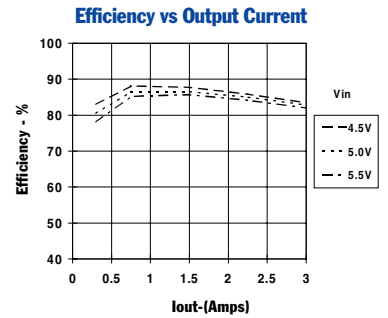
## Specifications

Characteristics (T <sub>a</sub> = 25°C unless noted)	Symbols	Conditions	PT6400 SERIES			
			Min	Typ	Max	Units
Output Current	I <sub>o</sub>	4.5V ≤ V <sub>in</sub> ≤ 5.5V	0.1*	—	3.0	A
Current Limit	I <sub>cl</sub>	V <sub>in</sub> = +5V	—	3.6	5.0	A
Input Voltage Range	V <sub>in</sub>	0.1A ≤ I <sub>o</sub> ≤ 3.0A	4.5	—	5.5	V
Output Voltage Tolerance	ΔV <sub>o</sub>	V <sub>in</sub> = +5V, I <sub>o</sub> = 3.0A 0°C ≤ T <sub>a</sub> ≤ +70°C	V <sub>o</sub> -0.05	—	V <sub>o</sub> +0.05	V
Line Regulation	Reg <sub>line</sub>	4.5V ≤ V <sub>in</sub> ≤ 5.5V, I <sub>o</sub> = 3.0A	—	±10	±25	mV
Load Regulation	Reg <sub>load</sub>	V <sub>in</sub> = +5V, 0.3 ≤ I <sub>o</sub> ≤ 3.0A	—	±10	±25	mV
V <sub>o</sub> Ripple/Noise	V <sub>n</sub>	V <sub>in</sub> = 5V, I <sub>o</sub> = 3.0A	—	66	165	mV
Transient Response with C <sub>2</sub> = 100µF	t <sub>tr</sub> V <sub>os</sub>	I <sub>o</sub> step between 1.5A and 3.0A V <sub>o</sub> over/undershoot	— —	200 200	— —	µSec mV
Efficiency	η	V <sub>in</sub> = +5V, I <sub>o</sub> = 1.5A V <sub>o</sub> = 3.3V V <sub>o</sub> = 1.8V V <sub>o</sub> = 2.1V V <sub>o</sub> = 1.2V	— — — —	85 74 77 63	— — — —	% % % %
Switching Frequency	f <sub>o</sub>	4.5V ≤ V <sub>in</sub> ≤ 5.5V 0.3A ≤ I <sub>o</sub> ≤ 3.0A	500	650	800	kHz
Absolute Maximum Operating Temperature Range	T <sub>a</sub>		0	—	+85	°C
Recommended Operating Temperature Range	T <sub>a</sub>	Free Air Convection (40-60 LFM) At V <sub>in</sub> = 5V, I <sub>o</sub> = 2.5A	0	—	+70**	°C
Thermal Resistance	θ <sub>ja</sub>	Free Air Convection (40-60 LFM)	—	25	—	°C/W
Storage Temperature	T <sub>s</sub>		-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	—	15	—	G's
Weight	—		—	6.5	—	grams

\*ISR will operate down to no load with reduced specifications

\*\*See Thermal Derating chart.

**Note:** The PT6400 Series requires two 100µF electrolytic or tantalum capacitors for proper operation in all applications.

**3 Amp 5V Input Adjustable  
Integrated Switching Regulator**
**PT6408, 1.2 VDC** (See Note 1)**PT6407, 2.1 VDC** (See Note 1)**PT6405, 3.3 VDC** (See Note 1)

**Note 1:** All data listed in the above graphs, except for derating data, has been developed from actual products tested at 25°C. This data is considered typical data for the ISR.

**Note 2:** Thermal derating graphs are developed in free air convection cooling of 40-60 LFM. (See Thermal Application Notes.)

## Adjusting the Output Voltage of the PT6400 Series 3AMP 5V Bus Converters

The output voltage of the Power Trends PT6400 Series ISRs may be adjusted higher or lower than the factory trimmed pre-set voltage with the addition of a single external resistor. Table 1 accordingly gives the allowable adjustment range for each model in the series as  $V_a$  (min) and  $V_a$  (max).

**Adjust Up:** (See note 1) An increase in the output voltage is obtained by adding a resistor R1, between pin 12 ( $V_o$  adjust) and pins 9-11 ( $V_{out}$ ).

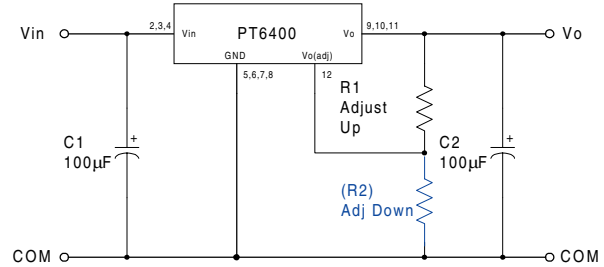
**Adjust Down:** (See note 1) Add a resistor (R2), between pin 12 ( $V_o$  adjust) and pins 5-8 (GND).

Refer to Figure 1 and Table 2 for both the placement and value of the required resistor; either R1 or (R2) as appropriate.

### Notes:

1. The direction in which each resistor adjusts the output of the PT6400 series differs from many other Power Trends products. These output voltage adjustment notes are therefore specific only to the PT6400 models.
2. Use only a single 1% resistor in either the R1 or (R2) location. Place the resistor as close to the ISR as possible.
3. Never connect capacitors from  $V_o$  adjust to either GND or  $V_{out}$ . Any capacitance added to the  $V_o$  adjust pin will affect the stability of the ISR.
4. An increase in the output voltage may place additional limits on the input voltage range of the part. The revised minimum input voltage will be ( $V_{out} + 1.2$ ) or 4.5V, whichever is higher. Do not exceed 5.5Vdc.

Figure 1



The values of R1 [adjust up], and (R2) [adjust down], can also be calculated using the following formulae.

$$R1 = \frac{12.45 V_o}{(V_a - V_o)} - 49.9 \text{ k}\Omega$$

$$(R2) = \frac{12.45 (2V_a - V_o)}{V_o - V_a} - 49.9 \text{ k}\Omega$$

Where:  $V_o$  = Original output voltage  
 $V_a$  = Adjusted output voltage

Table 1

### PT6400 ADJUSTMENT RANGE

Series Pt #	PT6408	PT6404	PT6406	PT6407	PT6409	PT6405
$V_o$ (nom)	1.2	1.5	1.8	2.1	2.5	3.3
$V_a$ (min)	1.1	1.3	1.5	1.8	2.1	2.8
$V_a$ (max)	1.4	1.8	2.2	2.6	3.1	3.8

## PT6400 Series

Table 2

## PT6400 ADJUSTMENT RESISTOR VALUES

Series Pt #	PT6408	PT6404	PT6406	PT6407	PT6409	PT6405
V <sub>0</sub> (nom)	1.2	1.5	1.8	2.1	2.5	3.3
V <sub>a</sub> (req'd)						
1.1	(74.6)kΩ					
1.15	(224.0)kΩ					
1.2						
1.25	249.0kΩ					
1.3	99.5kΩ	(18.6)kΩ				
1.35	49.7kΩ	(49.7)kΩ				
1.4	24.8kΩ	(112.0)kΩ				
1.45		(299.0)kΩ				
1.5			(0.0)kΩ			
1.55		324.0kΩ	(14.8)kΩ			
1.6		137.0kΩ	(37.3)kΩ			
1.65		74.6kΩ	(74.6)kΩ			
1.7		43.5kΩ	(149.0)kΩ			
1.75		24.8kΩ	(373.0)kΩ			
1.8		12.4kΩ		(12.4)kΩ		
1.85			398.0kΩ	(29.8)kΩ		
1.9			174.0kΩ	(55.9)kΩ		
1.95			99.5kΩ	(99.5)kΩ		
2.0			62.2kΩ	(187.0)kΩ		
2.05			39.7kΩ	(448.0)kΩ		
2.1			24.8kΩ		(3.0)kΩ	
2.15			14.1kΩ	473.0kΩ	(14.1)kΩ	
2.2			6.1kΩ	212.0kΩ	(29.0)kΩ	
2.25				124.0kΩ	(49.7)kΩ	
2.3				80.8kΩ	(80.8)kΩ	
2.35				54.7kΩ	(133.0)kΩ	
2.4				37.3kΩ	(236.0)kΩ	
2.45				24.8kΩ	(548.0)kΩ	
2.5				15.5kΩ		
2.55				8.2kΩ	573.0kΩ	
2.6				2.4kΩ	261.0kΩ	
2.65					158.0kΩ	
2.7					106.0kΩ	
2.75					74.6kΩ	
2.8					53.9kΩ	(7.4)kΩ
2.85					39.0kΩ	(16.5)kΩ
2.9					27.9kΩ	(27.9)kΩ
2.95					19.3kΩ	(42.6)kΩ
3.0					12.4kΩ	(62.2)kΩ
3.1					2.0kΩ	(131.0)kΩ
3.2						(336.0)kΩ
3.3						
3.4						361.0kΩ
3.5						156.0kΩ
3.6						87.0kΩ
3.7						52.8kΩ
3.8						32.3kΩ

R1 = Black R2 = (Blue)

**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)
PT6404D	LIFEBUY	SIP MODULE	ECA	12	12	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	
PT6404E	OBSOLETE	SIP MODULE	ECC	12		TBD	Call TI	Call TI	
PT6405B	LIFEBUY	SIP MODULE	ECK	12	12	Pb-Free (RoHS)	Call TI	Level-1-215C-UNLIM	
PT6405D	LIFEBUY	SIP MODULE	ECA	12	12	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	
PT6405E	LIFEBUY	SIP MODULE	ECC	12	12	Pb-Free (RoHS)	Call TI	Level-1-215C-UNLIM	
PT6405ET	LIFEBUY	SIP MODULE	ECC	12	200	Pb-Free (RoHS)	Call TI	Level-1-215C-UNLIM	
PT6405P	LIFEBUY	SIP MODULE	ECD	12	12	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	
PT6406D	LIFEBUY	SIP MODULE	ECA	12	12	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	
PT6406E	LIFEBUY	SIP MODULE	ECC	12	12	Pb-Free (RoHS)	Call TI	Level-1-215C-UNLIM	
PT6406P	LIFEBUY	SIP MODULE	ECD	12	12	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	
PT6407E	LIFEBUY	SIP MODULE	ECC	12	12	Pb-Free (RoHS)	Call TI	Level-1-215C-UNLIM	
PT6409D	LIFEBUY	SIP MODULE	ECA	12	12	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	
PT6409E	LIFEBUY	SIP MODULE	ECC	12	12	Pb-Free (RoHS)	Call TI	Level-1-215C-UNLIM	
PT6409P	LIFEBUY	SIP MODULE	ECD	12	12	Pb-Free (RoHS)	Call TI	N / A for Pkg Type	

<sup>(1)</sup> 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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