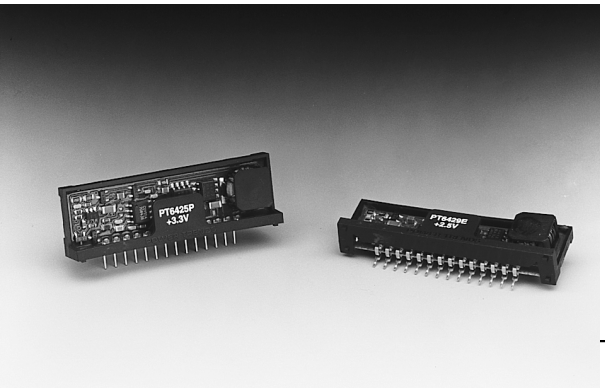
## 3 Amp 5V Input Adjustable Integrated Switching Regulator

SLTS033A

*(Revised 6/30/2000)*

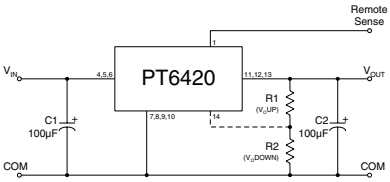


- Adjustable Output Voltage
- 85% Efficiency
- Small SIP Footprint
- Input Voltage Range: 4.5V to 5.5V
- Remote Sense Capability

The PT6420 series from Power Trends is a high performance +5V to +3.3V, 3Amp family of 14-Pin SIP (Single In-line Package) Integrated Switching Regulators (ISRs). Only two external capacitors are required for proper operation.

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

### Standard Application




$C_1$ = Required 100µF electrolytic
$C_2$ = Required 100µF electrolytic

### Pin-Out Information

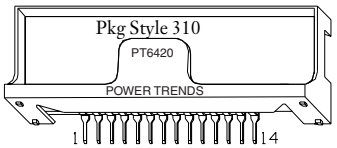
| Pin | Function |
|---|---|
| 1 | Remote Sense |
| 2 | Do not connect |
| 3 | Do not connect |
| 4 | $V_{in}$ |
| 5 | $V_{in}$ |
| 6 | $V_{in}$ |
| 7 | GND |
| 8 | GND |
| 9 | GND |
| 10 | GND |
| 11 | $V_{out}$ |
| 12 | $V_{out}$ |
| 13 | $V_{out}$ |
| 14 | $V_{out}$ Adjust |

### Ordering Information

**PT6424☐** = +1.5 Volts
**PT6425☐** = +3.3 Volts
**PT6426☐** = +1.8 Volts
**PT6427☐** = +2.1 Volts
**PT6428☐** = +1.2 Volts
**PT6429☐** = +2.5 Volts

### PT Series Suffix (PT1234X)

| Case/Pin Configuration | |
|---|---|
| Vertical Through-Hole | **P** |
| Horizontal Through-Hole | **D** |
| Horizontal Surface Mount | **E** |




Note: Back surface of product is conducting metal.

### Specifications

| Characteristics ($T_a$ = 25°C unless noted) | Symbols | Conditions | PT6420 SERIES Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Output Current | $I_o$ | 4.5V ≤ $V_{in}$ ≤ 5.5V | 0 | — | 3.0 | A |
| Current Limit | $I_{cl}$ | $V_{in}$ = +5V | — | 3.6 | 5.0 | A |
| Input Voltage Range | $V_{in}$ | 0.1A ≤ $I_o$ ≤ 3.0A | 4.5 | — | 5.5 | V |
| Output Voltage Tolerance | $\Delta V_o$ | $V_{in}$ = +5V, $I_o$ = 3.0A<br>0°C ≤ $T_a$ ≤ +70°C | $V_o$-0.05 | 3.3 | $V_o$+0.05 | V |
| Line Regulation | $Reg_{line}$ | 4.5V ≤ $V_{in}$ ≤ 5.5V, $I_o$ = 3.0A | — | ±10 | ±25 | mV |
| Load Regulation | $Reg_{load}$ | $V_{in}$ = +5V, 0.3 ≤ $I_o$ ≤ 3.0A | — | ±10* | ±25* | mV |
| $V_o$ Ripple/Noise | $V_n$ | $V_{in}$ = 5V, $I_o$ = 3.0A | — | 66 | 165 | mVpp |
| Transient Response<br>with $C_2$ = 100µF | $t_{tr}$<br>$V_{os}$ | $I_o$ step between 1.5A and 3.0A<br>$V_o$ over/undershoot | —<br>— | 200<br>200 | —<br>— | µSec<br>mV |
| Efficiency | η | $V_{in}$ = +5V, $I_o$ = 1.5A $V_o$= 3.3V<br>$V_o$= 1.8V<br>$V_o$= 2.1V<br>$V_o$= 1.2V | —<br>—<br>—<br>— | 85<br>74<br>77<br>63 | —<br>—<br>—<br>— | %<br>%<br>%<br>% |
| Switching Frequency | $f_o$ | 4.5V ≤ $V_{in}$ ≤ 5.5V<br>0.3A ≤ $I_o$ ≤ 3.0A | 500 | 650 | 800 | kHz |
| Absolute Maximum Operating Temperature Range | $T_a$ | | 0 | — | +85 | °C |
| Recommended Operating Temperature Range | $T_a$ | Free Air Convection (40-60 LFM)<br>At Vin= 5V, Io=2.5A | 0 | — | +70** | °C |
| Thermal Resistance | $\theta_{ja}$ | Free Air Convection (40-60 LFM) | — | 25 | — | °C/W |
| 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 | — | 15 | — | G's |
| Weight | — | — | — | 6.5 | — | grams |

*When used with remote sense function.

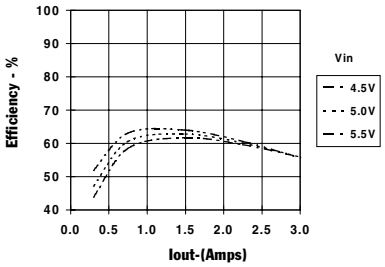
**See Thermal Derating chart.

***Note:*** *The PT6420 Series requires two 100µF electrolytic or tantalum capacitors for proper operation in all applications.*

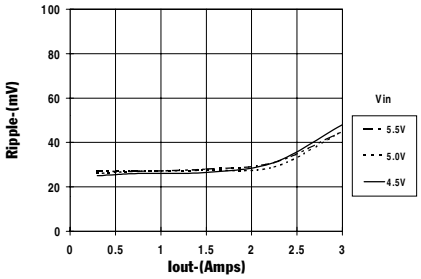
# Typical Characteristics

## PT6428 1.2 VDC (See Note 1)

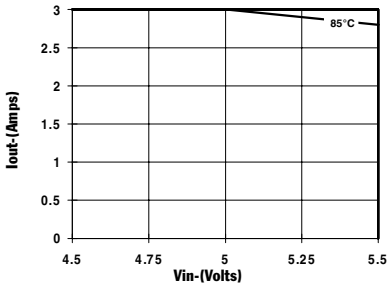
### Efficiency vs Output Current



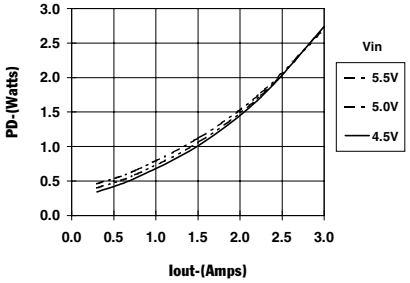

### Ripple vs Output Current




### Thermal Derating ($T_a$) (See Note 2)

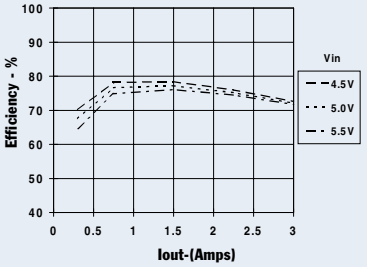



### Power Dissipation vs Output Current

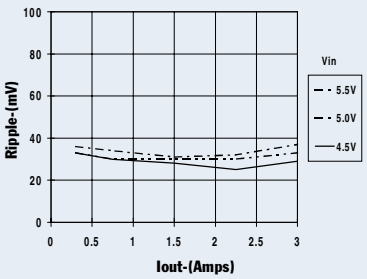



## PT6427, 2.1 VDC (See Note 1)

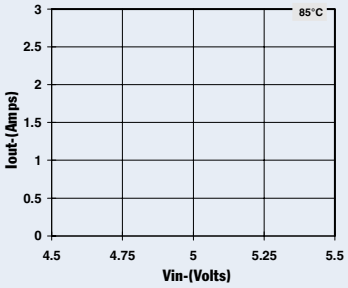
### Efficiency vs Output Current



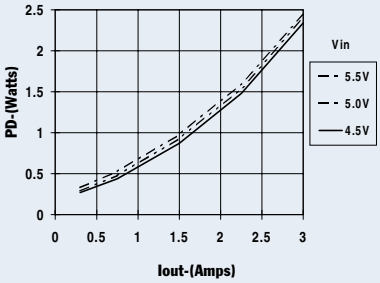

### Ripple vs Output Current




### Thermal Derating ($T_a$) (See Note 2)

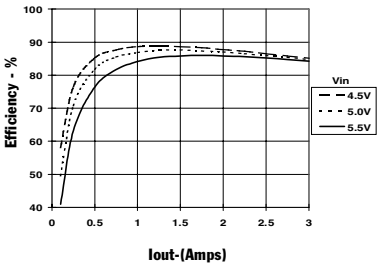



### Power Dissipation vs Output Current

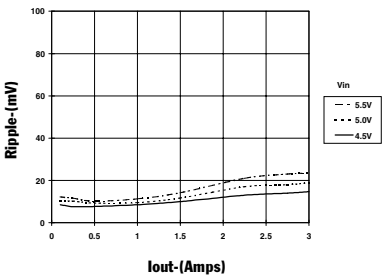



## PT6425, 3.3 VDC (See Note 1)

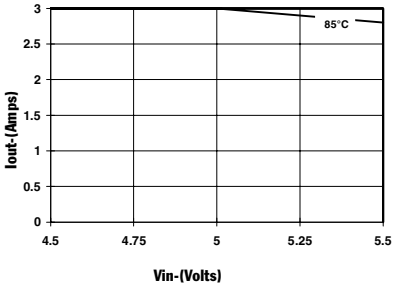
### Efficiency vs Output Current



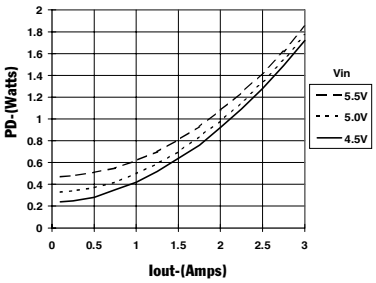

### Ripple vs Output Current




### Thermal Derating ($T_a$) (See Note 2)




### Power Dissipation vs Output Current




**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 PT6420 Series 3AMP 5V Bus Converters

The output voltage of the Power Trends PT6420 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 14 ($V_o$ adjust) and pins 11-13 ($V_{out}$).

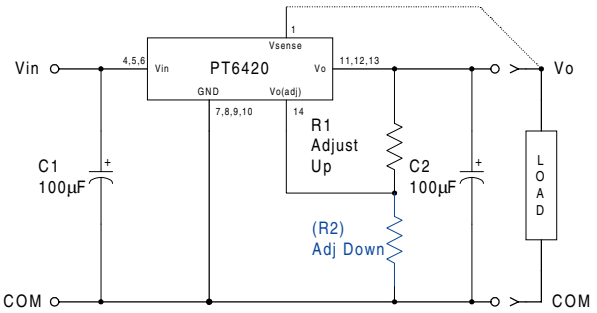
**Adjust Down:** (See note 1) Add a resistor (R2), between pin 14 ($V_o$ adjust) and pins 7-10 (GND).

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 PT6420 series differs from many other Power Trends products. These output voltage adjustment notes are therefore specific only to the PT6420 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, $V_{out}$, or the Remote Sense pin. Any capacitance added to the $V_o$ adjust pin will affect the stability of the ISR.
4. The PT6420 incorporates a Remote Sense (See Figure 1). If this feature is being used, connecting the resistor R1 between pin 14 ($V_o$ adjust) and pin 1 (Remote Sense) can benefit load regulation.
5. 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.

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

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

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

***Table 1***

**PT6420 ADJUSTMENT RANGE**

| Series Pt # | PT6428 | PT6424 | PT6426 | PT6427 | PT6429 | PT6425 |
|---|---|---|---|---|---|---|
| **$V_o$ (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 |

***Table 2***

**PT6420 ADJUSTMENT RESISTOR VALUES**

| Series Pt # | PT6428 | PT6424 | PT6426 | PT6427 | PT6429 | PT6425 |
|---|---|---|---|---|---|---|
| $V_o$ (nom) | 1.2 | 1.5 | 1.8 | 2.1 | 2.5 | 3.3 |
| $V_a$ (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 (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PT6425D | OBSOLETE | SIP MODULE | EDA | 14 | | 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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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