

# PT6670 Series

5V/3.3V Input 20W Boost  
Integrated Switching Regulator

**Power Trends Products**  
from Texas Instruments

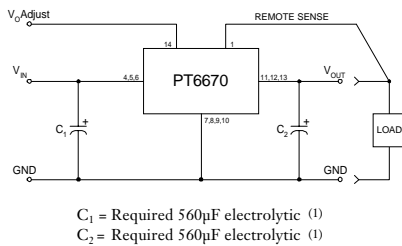
**SLTS039A**

(Revised 6/30/2000)

- Input Voltage Range:  
3.1 to 3.6V  
4.5 to 5.5V
- Adjustable Output Voltage
- 85% Efficiency
- Remote Sense Capability
- Soft Start

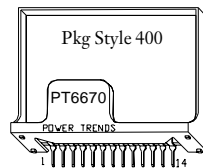
The PT6670 is a series of high-output Integrated Switching Regulators (ISRs) designed to provide a voltage boost function. Housed in a 14-Pin SIP (Single In-line Package), the PT6670 series incorporates regulators for either a +3.3V or +5.0V input and provide output voltages from +5V to +12V. Applications include power for auxilliary circuits requiring up to 20W.

## Standard Application



## Pin-Out Information

| Pin | Function        | Pin | Function                |
|-----|-----------------|-----|-------------------------|
| 1   | Remote Sense    | 8   | GND                     |
| 2   | Do not connect  | 9   | GND                     |
| 3   | Do not connect  | 10  | GND                     |
| 4   | V <sub>in</sub> | 11  | V <sub>out</sub>        |
| 5   | V <sub>in</sub> | 12  | V <sub>out</sub>        |
| 6   | V <sub>in</sub> | 13  | V <sub>out</sub>        |
| 7   | GND             | 14  | V <sub>out</sub> Adjust |



Note:  
Back surface is  
conducting metal.

## Ordering Information

| +3.3V Input | +5V Input | V <sub>out</sub> |
|-------------|-----------|------------------|
| PT6671      | —         | +5.0 Volts       |
| PT6672      | PT6675    | +9.0 Volts       |
| PT6673      | PT6674    | +12.0 Volts      |

## PT Series Suffix (PT1234X)

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

## Preliminary Specifications

| Characteristics<br>(T <sub>a</sub> = 25°C unless noted)                  | Symbols                            | Conditions  | PT6670 SERIES   |                            |  |                              |
|--|------------------------------------|---|---|----------------------------|--|------------------------------|
|  |                                    |   | Min   | Typ                        | Max                                      | Units                        |
| Output Current   | I <sub>o</sub>                     | T <sub>a</sub> = 60°C, 200 LFM, pkg P<br>T <sub>a</sub> = 25°C, natural convection                          | PT6671<br>0.1<br>PT6672<br>0.1<br>PT6673<br>0.1<br>PT6674<br>0.1<br>PT6675<br>0.1 | —                          | TBD<br>4.0<br>1.67<br>1.25<br>2.0<br>3.0 | A                            |
| Input Voltage Range  | V <sub>in</sub>                    | Over V <sub>o</sub> and I <sub>o</sub> range  | PT6671/2/3<br>3.1<br>PT6674/5<br>4.5  | 3.3<br>5.0                 | 3.6<br>5.5                               | V                            |
| Inrush Current   | I <sub>ir</sub>                    | On start-up   | —   | —                          | TBD                                      | A                            |
| Output Voltage Tolerance   | ΔV <sub>o</sub>                    | V <sub>in</sub> = V <sub>in(TYP)</sub> , I <sub>o</sub> = I <sub>omax</sub><br>T <sub>a</sub> = 0°C to 65°C | —   | 1.5                        | —  | %V <sub>o</sub>              |
| Output Voltage Adjust Range  | V <sub>oadj</sub>                  | Pin 14 to V <sub>o</sub> or ground  | PT6671<br>3.8<br>PT6672/5<br>8.2<br>PT6673/4<br>9.6                               | —                          | 5.5<br>9.2<br>12.8                       | V                            |
| Line Regulation  | Reg <sub>line</sub>                | Over V <sub>in</sub> range, I <sub>o</sub> = I <sub>omax</sub>  | —   | ±0.25                      | ±0.5                                     | %V <sub>o</sub>              |
| Load Regulation  | Reg <sub>load</sub>                | V <sub>in</sub> = V <sub>in(TYP)</sub> , 0.1 ≤ I <sub>o</sub> ≤ I <sub>omax</sub>                           | —   | ±0.25                      | ±0.5                                     | %V <sub>o</sub>              |
| V <sub>o</sub> Ripple/Noise  | V <sub>n</sub>                     | V <sub>in</sub> = V <sub>in(TYP)</sub> , I <sub>o</sub> = I <sub>omax</sub>                                 | —   | 3                          | —  | %V <sub>o</sub>              |
| Transient Response<br>with C <sub>1</sub> = C <sub>2</sub> = 560 $\mu$ F | t <sub>tr</sub><br>V <sub>os</sub> | I <sub>o</sub> step between ½I <sub>omax</sub> and I <sub>omax</sub><br>V <sub>o</sub> over/undershoot      | —   | 500<br>5                   | —  | $\mu$ Sec<br>%V <sub>o</sub> |
| Efficiency   | η                                  | V <sub>in</sub> = V <sub>in(TYP)</sub> , I <sub>o</sub> = ½I <sub>omax</sub>                                | PT6671<br>—<br>PT6672<br>—<br>PT6673<br>—<br>PT6675<br>—<br>PT6674<br>—           | 85<br>84<br>83<br>88<br>87 | —  | %                            |
|  |                                    | V <sub>in</sub> = V <sub>in(TYP)</sub> , I <sub>o</sub> = I <sub>omax</sub>                                 | PT6671<br>—<br>PT6672<br>—<br>PT6673<br>—<br>PT6675<br>—<br>PT6674<br>—           | 82<br>80<br>82<br>87<br>86 | —  | %                            |

(Continued)

# PT6670 Series

5V/3.3V Input 20W Boost  
Integrated Switching Regulator

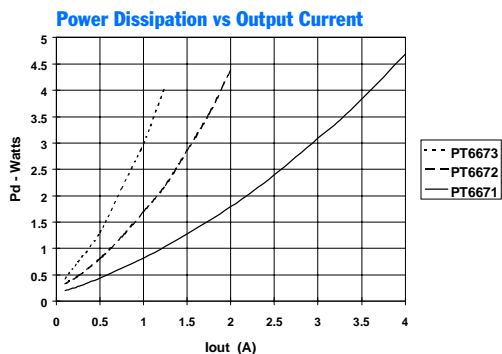
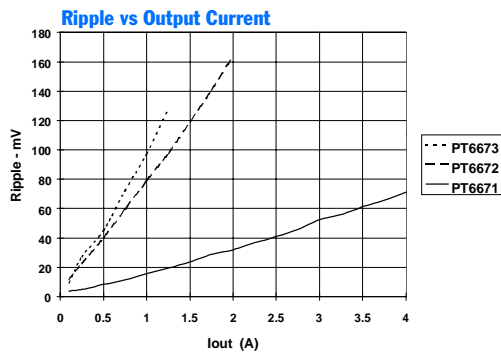
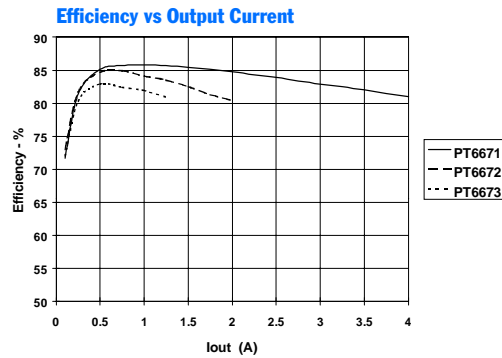
## Preliminary Specifications (continued)

| Characteristics<br>( $T_a = 25^\circ\text{C}$ unless noted) | Symbols | Conditions  | PT6670 SERIES |     |      | Units            |
|---|---------|---|---------------|-----|------|------------------|
|   |         |   | Min           | Typ | Max  |                  |
| Switching Frequency   | $f_o$   | Over $V_{in}$ range<br>$0.1\text{A} \leq I_o \leq I_{omax}$                     | —             | 300 | —    | kHz              |
| Absolute Maximum<br>Operating Temperature Range             | $T_a$   |   | -40           | —   | +85  | $^\circ\text{C}$ |
| Recommended Operating<br>Temperature Range                  | $T_a$   | Free Air Convection (40-60 LFM)<br>Over $V_{in}$ and $I_o$ ranges with heat tab | -40           | —   | +65  | $^\circ\text{C}$ |
| Storage Temperature   | $T_s$   | —   | -40           | —   | +125 | $^\circ\text{C}$ |
| Mechanical Shock  | —       | Per Mil-STD-883D, Method 2002.3   | —             | 500 | —    | G's              |
| Mechanical Vibration  | —       | Per Mil-STD-883D, Method 2007.2,<br>20-2000 Hz, soldered in a PC board          | —             | 7.5 | —    | G's              |
| Weight  | —       | —   | —             | 14  | —    | grams            |

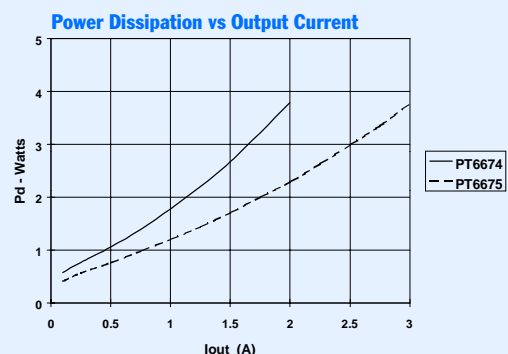
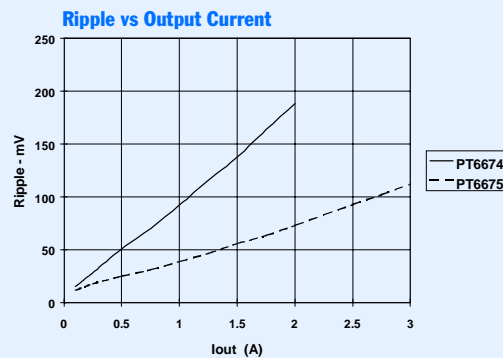
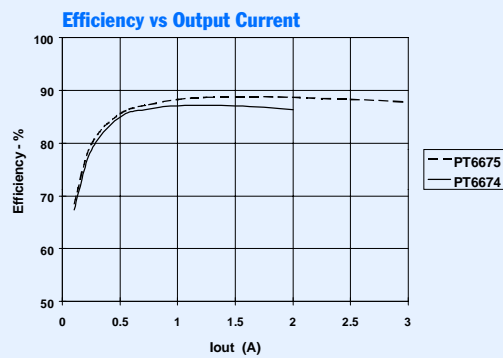
**Notes:** (1) The PT6670 Series requires two 560 $\mu\text{F}$  electrolytic capacitors (input and output) for proper operation in all applications.  
(2) This product does not include short circuit protection.

## TYPICAL CHARACTERISTICS

PT6671/2/3 (@  $V_{in}=+3.3\text{V}$ ) (See Note A)



PT6674/5 Series (@  $V_{in}=+5.0\text{V}$ ) (See Note A)



**Note A:** All characteristic data in the above graphs has been developed from actual products tested at  $25^\circ\text{C}$ . This data is considered typical data for the ISR.

## PT6670 Series

### Adjusting the Output Voltage of the PT6670 Series Boost Voltage ISR

The Power Trends PT6670 ISRs are a series of converters that operate from a 3.3V or 5V input bus voltage. In each case, the output voltage can be adjusted higher or lower than the factory trimmed pre-set voltage. Adjustment requires the addition of a single external resistor. Table 1 gives the permissible adjustment range for each model in the series as  $V_a(\text{min})$  and  $V_a(\text{max})$  respectively.

**Adjust Up:** To increase the output, add a resistor R2 between pin 14 ( $V_o$  Adjust) and pins 7-10 (GND).

**Adjust Down:** Add a resistor (R1), between pin 14 ( $V_o$  Adjust) and pin 1 (Remote Sense).

Refer to Figure 1 and Table 2 for both the placement and value of the required resistor.

#### Notes:

1. Use only a single 1% resistor in either the (R1) or R2 location. Place the resistor as close to the ISR as possible.
2. Do not exceed the maximum advised adjustment voltage. Doing so could over stress the part.
3. Never connect capacitors to the  $V_o$  Adjust control pin. Any capacitance added to this pin will affect the stability of the ISR.
4. In the case of the PT6671, when the output is adjusted lower than the pre-trimmed output, the maximum input voltage to the ISR should not exceed  $(V_o - 0.5)V$ .

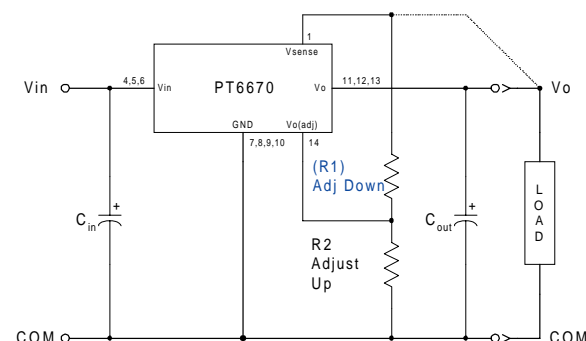
The adjust up and adjust down resistor values can also be calculated using the following formulas. Be sure to select the correct formula parameters from Table 1 for the model being adjusted.

$$(R1) = \frac{K_o (V_a - 2.5)}{2.5 (V_o - V_a)} - R_s \text{ k}\Omega$$

$$R2 = \frac{K_o}{V_a - V_o} - R_s \text{ k}\Omega$$

Where:  $V_o$  = Original output voltage  
 $V_a$  = Adjusted output voltage  
 $K_o$  = The multiplier constant in Table 1  
 $R_s$  = The series resistance from Table 1

**Figure 1**



**Table 1**

**PT6670 ADJUSTMENT RANGE AND FORMULA PARAMETERS**

| Series Pt #                                      |               |               |               |
|--|---------------|---------------|---------------|
| <b>3.3V Bus</b>                                  | <b>PT6671</b> | <b>PT6672</b> | <b>PT6673</b> |
| <b>5.0V Bus</b>                                  |               | <b>PT6675</b> | <b>PT6674</b> |
| <b><math>V_o(\text{nom})</math></b>              | 5.0V          | 9.0V          | 12.0V         |
| <b><math>V_a(\text{min})</math></b>              | 3.8V          | 8.2V          | 9.6V          |
| <b><math>V_a(\text{max})</math></b>              | 5.5V          | 9.2V          | 12.8V         |
| <b><math>K_o</math> (V-k<math>\Omega</math>)</b> | 25.0          | 48.75         | 47.41         |
| <b><math>R_s</math> (k<math>\Omega</math>)</b>   | 4.99          | 80.6          | 54.9          |

**Table 2**

**PT6670 ADJUSTMENT RESISTOR VALUES**

| Series Pt #                           |                   |               |                   |
|---------------------------------------|-------------------|---------------|-------------------|
| <b>3.3V Bus</b>                       | <b>PT6671</b>     | <b>PT6672</b> | <b>PT6673</b>     |
| <b>5.0V Bus</b>                       |                   | <b>PT6675</b> | <b>PT6674</b>     |
| <b><math>V_o(\text{nom})</math></b>   | 5.0V              | 9.0V          | 12.0V             |
| <b><math>V_a(\text{req'd})</math></b> |                   |               |                   |
| 3.8                                   | (5.8)k $\Omega$   | 8.2           | (58.3)k $\Omega$  |
| 3.9                                   | (7.7)k $\Omega$   | 8.4           | (111.0)k $\Omega$ |
| 4.0                                   | (10.0)k $\Omega$  | 8.6           | (217.0)k $\Omega$ |
| 4.1                                   | (12.8)k $\Omega$  | 8.8           | (534.0)k $\Omega$ |
| 4.2                                   | (16.3)k $\Omega$  | 9.0           |                   |
| 4.3                                   | (20.7)k $\Omega$  | 9.2           | 163.0k $\Omega$   |
| 4.4                                   | (26.7)k $\Omega$  | 9.4           |                   |
| 4.5                                   | (35.0)k $\Omega$  | 9.6           | (1.2)k $\Omega$   |
| 4.6                                   | (47.5)k $\Omega$  | 9.8           | (8.0)k $\Omega$   |
| 4.7                                   | (68.3)k $\Omega$  | 10.0          | (16.2)k $\Omega$  |
| 4.8                                   | (110.0)k $\Omega$ | 10.2          | (26.2)k $\Omega$  |
| 4.9                                   | (235.0)k $\Omega$ | 10.4          | (38.7)k $\Omega$  |
| 5.0                                   |                   | 10.6          | (54.8)k $\Omega$  |
| 5.1                                   | 245.0k $\Omega$   | 10.8          | (76.3)k $\Omega$  |
| 5.2                                   | 120.0k $\Omega$   | 11.0          | (106.0)k $\Omega$ |
| 5.3                                   | 78.3k $\Omega$    | 11.2          | (151.0)k $\Omega$ |
| 5.4                                   | 57.5k $\Omega$    | 11.4          | (226.0)k $\Omega$ |
| 5.5                                   | 45.0k $\Omega$    | 11.6          | (376.0)k $\Omega$ |
|                                       |                   | 11.8          | (827.0)k $\Omega$ |
|                                       |                   | 12.0          |                   |
|                                       |                   | 12.2          | 182.0k $\Omega$   |
|                                       |                   | 12.4          | 63.3k $\Omega$    |
|                                       |                   | 12.6          | 24.1k $\Omega$    |
|                                       |                   | 12.8          | 4.4k $\Omega$     |

R1 = (Blue)

R2 = Black

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**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| PT6671D          | ACTIVE                | SIP MOD ULE  | EEA             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6671E          | ACTIVE                | SIP MOD ULE  | EEC             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6671L          | ACTIVE                | SIP MOD ULE  | EEL             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6671M          | ACTIVE                | SIP MOD ULE  | EEM             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6671P          | ACTIVE                | SIP MOD ULE  | EED             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6673E          | ACTIVE                | SIP MOD ULE  | EEC             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6673F          | ACTIVE                | SIP MOD ULE  | EEF             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6673P          | ACTIVE                | SIP MOD ULE  | EED             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6674D          | ACTIVE                | SIP MOD ULE  | EEA             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6674E          | ACTIVE                | SIP MOD ULE  | EEC             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6674P          | ACTIVE                | SIP MOD ULE  | EED             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT6675L          | ACTIVE                | SIP MOD ULE  | EEL             | 14   | 12          | TBD                     | Call TI          | Level-1-215C-UNLIM           |

<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.

<sup>(2)</sup> 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)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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