

### Features

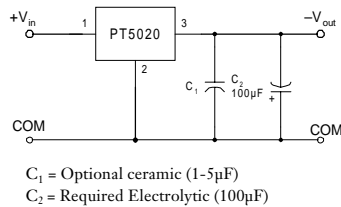
- Negative Output
- Input Voltage Range: +4.75 to +7 Volts
- Laser-Trimmed
- Small Footprint
- Soft Start
- 5-Pin Mount Option (Suffixes L & M)

### Description

The PT5020 series of integrated switching regulators (ISRs) convert a positive input voltage, typically +5V, to a negative output voltage for a wide range of analog and datacom applications.

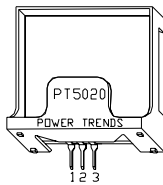
These Plus to Minus ISRs incorporate a “Buck-Boost” topology and are packaged in the 3-pin, single in-line pin (SIP) package configuration.

### Standard Application



### Pin-Out Information

| Pin | Function  |
|-----|-----------|
| 1   | $V_{in}$  |
| 2   | GND       |
| 3   | $V_{out}$ |



### Ordering Information

- PT5021 □ = -3.3 Volts  
 PT5022 □ = -5 Volts  
 PT5023 □ = -9 Volts  
 PT5024 □ = -12 Volts  
 PT5025 □ = -15 Volts  
 PT5026 □ = -5.2 Volts  
 PT5027 □ = -8.0 Volts  
 PT5028 □ = -6.5 Volts  
 PT5029 □ = -5.5 Volts  
 PT5030 □ = -6.0 Volts  
 PT5031 □ = -1.7 Volts

### PT Series Suffix (PT1234x)

| Case/Pin Configuration | Order Suffix | Package Code* |
|------------------------|--------------|---------------|
| Vertical               | <b>N</b>     | (EAD)         |
| Horizontal             | <b>A</b>     | (EAA)         |
| SMD                    | <b>C</b>     | (EAC)         |
| Horizontal, 2-pin Tab  | <b>M</b>     | (EAM)         |
| SMD, 2-Pin Tab         | <b>L</b>     | (EAL)         |

\* Previously known as package styles 100/110.  
 (Reference the applicable package code drawing for the dimensions and PC board layout)

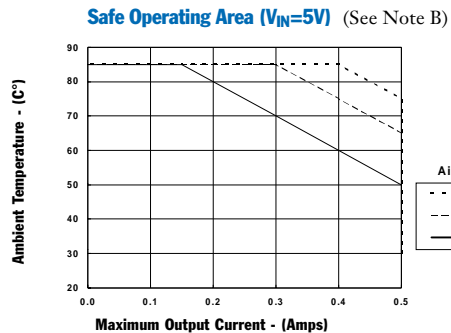
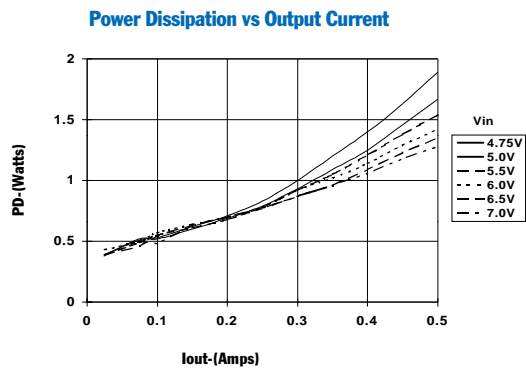
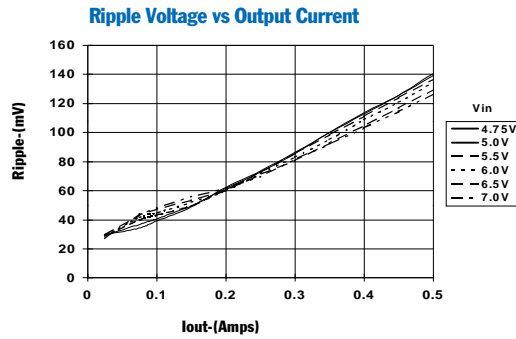
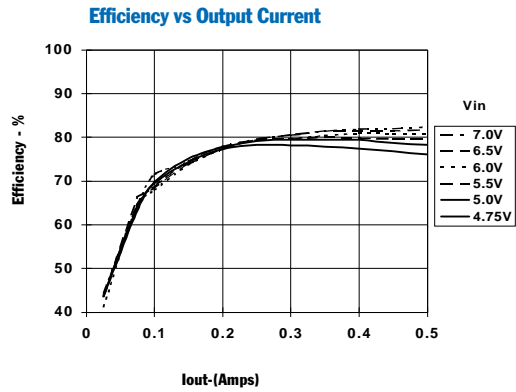
NOTE: PT5020 ISRs are not Short-Circuit Protected.

### Specifications (Unless otherwise stated, $T_a = 25^\circ\text{C}$ , $V_{in} = 5\text{V}$ , $I_o = I_{o,max}$ , $C_2 = 100\mu\text{F}$ )

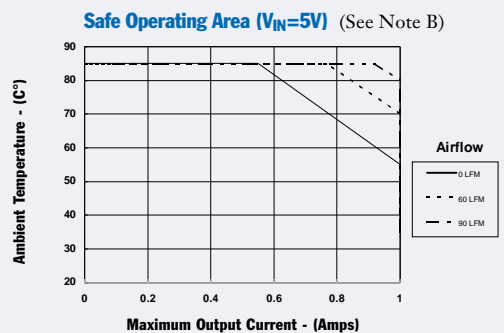
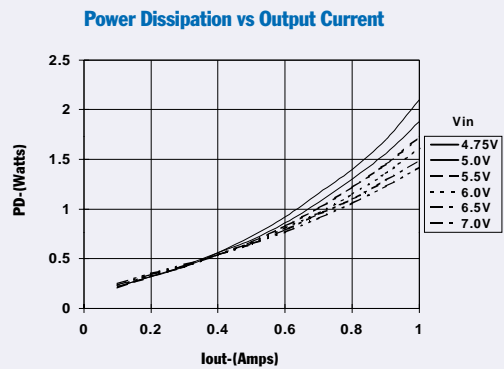
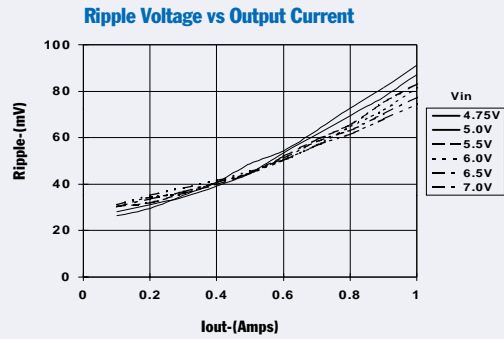
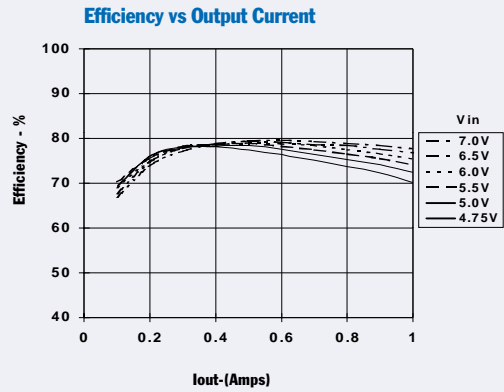
| Characteristics              | Symbol        | Conditions   | PT5020 SERIES                                     |           |            | Units              |
|------------------------------|---------------|--|---|-----------|------------|--------------------|
|                              |               |  | Min   | Typ       | Max        |                    |
| Output Current               | $I_o$         | Over $V_{in}$ range  | $V_o = -1.7\text{V to } -6.5\text{V}$<br>0.25 (1) | —         | 1.0        | A                  |
|                              |               |  | $V_o = -9\text{V}$<br>0.10 (1)                    | —         | 0.60       |                    |
|                              |               |  | $V_o = -12\text{V}$<br>0.10 (1)                   | —         | 0.50       |                    |
|                              |               |  | $V_o = -15\text{V}$<br>0.10 (1)                   | —         | 0.30       |                    |
| Input Voltage Range          | $V_{in}$      | Over $I_o$ range   | 4.75  | —         | 7 (2)      | V                  |
| Output Voltage Tolerance     | $\Delta V_o$  | Over $V_{in}$ Range<br>$T_a = -20^\circ\text{C to SOA limit } (3)$         | —   | $\pm 1.5$ | $\pm 3$    | % $V_o$            |
| Line Regulation              | $Reg_{line}$  | Over $V_{in}$ range  | —   | $\pm 0.5$ | $\pm 1$    | % $V_o$            |
| Load Regulation              | $Reg_{load}$  | $I_{o,min} \leq I_o \leq I_{o,max}$  | —   | $\pm 0.5$ | $\pm 1$    | % $V_o$            |
| Efficiency                   | $\eta$        | $I_o = 0.5 I_{o,max}$  | —   | 75        | —          | %                  |
| $V_o$ Ripple (pk-pk)         | $V_r$         | 20MHz bandwidth  | —   | $\pm 2$   | $\pm 5$    | % $V_o$            |
| Transient Response           | $t_{tr}$      | 25% load change<br>$V_o$ over/undershoot                                   | —   | 500       | —          | $\mu\text{Sec}$    |
|                              |               |  | —   | 3.0       | 5.0        | % $V_o$            |
| Current Limit                | $I_{lim}$     |  | —   | 150       | —          | % $I_{o,max}$      |
| Inrush Current               | $I_{ir}$      | On start up  | —   | 1.0 (3)   | —          | A                  |
|                              | $t_{ir}$      |  | —   | 1.0       | —          | mSec               |
| Switching Frequency          | $f_s$         | Over $I_o$ range   | $ V_o  = 1.7 \text{ to } 8\text{V}$<br>0.8<br>500 | 1<br>650  | 1.2<br>800 | MHz<br>kHz         |
| Operating Temperature Range  | $T_a$         | —  | -20   | —         | +85 (4)    | $^\circ\text{C}$   |
| Thermal Resistance           | $\theta_{ja}$ | Free Air Convection<br>(40-60LFM)  | —   | 50        | —          | $^\circ\text{C/W}$ |
| Storage Temperature          | $T_s$         |  | -40   | —         | +125       | $^\circ\text{C}$   |
| Mechanical Shock             |               | Per Mil-STD-883D, Method 2002.3<br>1 msec, Half Sine, mounted to a fixture | —   | 500       | —          | G's                |
| Mechanical Vibration         |               | Suffixes N, A, & C   | —   | 5         | —          | G's                |
| Per Mil-STD-883D, 20-2000 Hz |               | Suffixes L & M   | —   | 20        | —          |                    |
| Weight                       |               | Suffixes N, A, & C   | —   | 4.5       | —          | grams              |
|                              |               | Suffixes L & M   | —   | 6.5 (5)   | —          |                    |

- Notes:** (1) The ISR will operate at no load with reduced specifications.  
 (2) For applications with input voltages greater than 7 VDC, use the PT78NR100 Series.  
 (3) The inrush current stated is above the normal input current for the associated output load.  
 (4) See Safe Operating Area curves or consult the factory for the appropriate derating  
 (5) The tab pins on the 5-pin mount package types (suffixes L & M) must be soldered. For more information see the applicable package outline drawing.

**PT5024 (-12VDC)** (See Note A)



**PT5022 (-5VDC)** (See Note A)



**Note A:** Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the Converter.  
**Note B:** Thermal derating graphs are developed in free-air convection cooling, which corresponds to approximately 40–60LFM of airflow.

**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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| PT5021A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5021C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5021J          | ACTIVE                | SIP MOD ULE  | EAJ             | 3    | 16          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5021L          | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5021N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5022A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5022C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5022CT         | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 200         | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5022H          | ACTIVE                | SIP MOD ULE  | EAH             | 3    | 16          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5022L          | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5022M          | ACTIVE                | SIP MOD ULE  | EAM             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5022N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5022S          | ACTIVE                | SIP MOD ULE  | EAF             | 3    | 16          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5023A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5023C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5023N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5024A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5024C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5024CT         | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 200         | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5024J          | ACTIVE                | SIP MOD ULE  | EAJ             | 3    | 16          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5024L          | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5024M          | ACTIVE                | SIP MOD ULE  | EAM             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5024N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5025A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5025C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |

| 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| PT5025H          | ACTIVE                | SIP MOD ULE  | EAH             | 3    | 16          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5025L          | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5025N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5026A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5026C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5026CT         | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 200         | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5026H          | ACTIVE                | SIP MOD ULE  | EAH             | 3    | 16          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5026L          | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5026LT         | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 200         | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5026M          | ACTIVE                | SIP MOD ULE  | EAM             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5026N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5027A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5027C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5027N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5028A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5028N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5029A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5029C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5029M          | ACTIVE                | SIP MOD ULE  | EAM             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5030A          | ACTIVE                | SIP MOD ULE  | EAA             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5030C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5030L          | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | Level-1-215C-UNLIM           |
| PT5030N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | Pb-Free (RoHS)          | Call TI          | N / A for Pkg Type           |
| PT5031C          | ACTIVE                | SIP MOD ULE  | EAC             | 3    | 35          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT5031L          | ACTIVE                | SIP MOD ULE  | EAL             | 3    | 35          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| PT5031N          | ACTIVE                | SIP MOD ULE  | EAD             | 3    | 35          | TBD                     | Call TI          | Level-1-215C-UNLIM           |

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(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.

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| Data Converters       | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     | Automotive          | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>         |
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