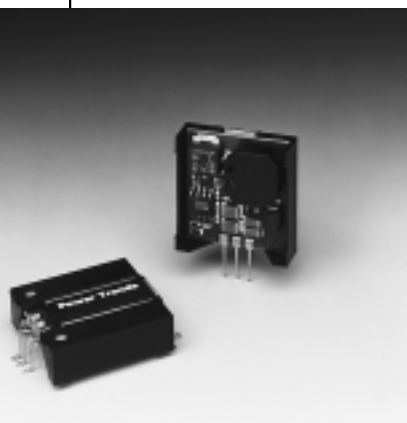
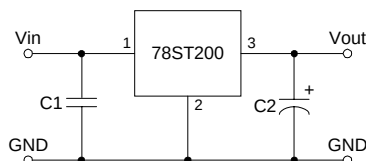


**78ST200 Series****2 AMP POSITIVE STEP-DOWN  
INTEGRATED SWITCHING REGULATOR****Revised 6/30/98**

- High Efficiency > 82%
- Wide Input Range
- Self-Contained Inductor
- Short-Circuit Protection
- Over-Temperature Protection
- Fast Transient Response

The 78ST200 is a series of wide input voltage, 3 terminal Integrated Switching Regulators (ISRs). Employing a ceramic substrate, these ISRs have a maximum output current of 2A. The output voltage is laser trimmed for high accuracy.

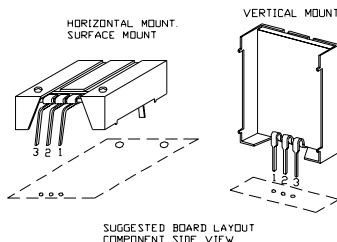
The 78ST200 series regulators have internal short-circuit and over-temperature protection and may be used in a wide variety of applications.

**Standard Application**

C1 = Optional 1 $\mu$ F ceramic  
C2 = Required 100 $\mu$ F electrolytic

**Pin-Out Information**

| Pin No. | Function  |
|---------|-----------|
| 1       | $V_{in}$  |
| 2       | GND       |
| 3       | $V_{out}$ |

**Ordering Information****78ST2 XX Y C**

Output Voltage

**33** = 3.3 Volts  
**35** = 3.45 Volts  
**05** = 5.0 Volts

Package Suffix

**V** = Vertical Mount  
**S** = Surface Mount  
**H** = Horizontal Mount

(For dimensions and PC board layout see Package Style 500.)

**Specifications**

| Characteristics<br>( $T_a = 25^\circ\text{C}$ unless noted) | Symbols             | Conditions                                                                                 | 78ST200 SERIES |            |           |                            |
|-------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------|----------------|------------|-----------|----------------------------|
|                                                             |                     |                                                                                            | Min            | Typ        | Max       | Units                      |
| Output Current                                              | $I_o$               | Over $V_{in}$ range                                                                        | 0.1*           | —          | 2.0       | A                          |
| Input Voltage Range                                         | $V_{in}$            | $I_o = 0.1$ to $3.0\text{A}$ $V_o < 3.5\text{V}$<br>$V_o = 5.0\text{V}$                    | 7<br>8         | —          | 15<br>20  | V<br>V                     |
| Output Voltage Tolerance                                    | $\Delta V_o$        | Over $V_{in}$ range, $I_o = 2.0\text{A}$<br>$T_a = 0^\circ\text{C}$ to $+60^\circ\text{C}$ | —              | $\pm 1.0$  | $\pm 2.0$ | % $V_o$                    |
| Line Regulation                                             | $\text{Reg}_{line}$ | Over $V_{in}$ range                                                                        | —              | $\pm 0.4$  | $\pm 0.8$ | % $V_o$                    |
| Load Regulation                                             | $\text{Reg}_{load}$ | $0.1 \leq I_o \leq 2.0\text{A}$                                                            | —              | $\pm 0.2$  | $\pm 0.4$ | % $V_o$                    |
| Ripple/Noise                                                | $V_n$               | $V_{in} = V_{in\text{ min}}$ , $I_o = 2.0\text{A}$                                         | —              | 1          | —         | % $V_o$                    |
| Transient Response<br>(with 100 $\mu\text{F}$ output cap)   | $t_{tr}$            | 50% load change<br>$V_o$ over/undershoot                                                   | —              | 100<br>5.0 | —         | $\mu\text{Sec}$<br>% $V_o$ |
| Efficiency                                                  | $\eta$              | $V_{in} = 9\text{V}$ , $I_o = 2.0\text{A}$ , $V_o = 5\text{V}$                             | —              | 82         | —         | %                          |
| Switching Frequency                                         | $f_o$               | Over $V_{in}$ and $I_o$ ranges                                                             | 0.95           | 1.0        | 1.05      | MHz                        |
| Absolute Maximum<br>Operating Temperature Range             | $T_a$               | —                                                                                          | -40            | —          | +85       | $^\circ\text{C}$           |
| Recommended Operating<br>Temperature Range                  | $T_a$               | Free Air Convection, (40-60LFM)<br>Over $V_{in}$ and $I_o$ ranges                          | -40            | —          | +85**     | $^\circ\text{C}$           |
| Thermal Resistance                                          | $\theta_{ja}$       | Free Air Convection, (40-60LFM)                                                            | —              | 38         | —         | $^\circ\text{C}/\text{W}$  |
| 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                     | —              | 5          | —         | G's                        |
| Weight                                                      | —                   | —                                                                                          | —              | 7          | —         | Grams                      |

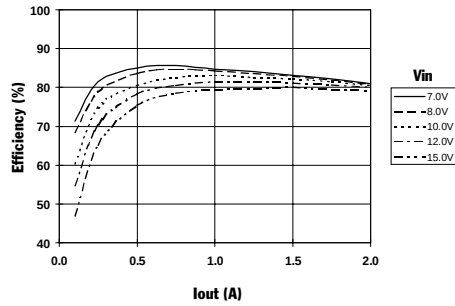
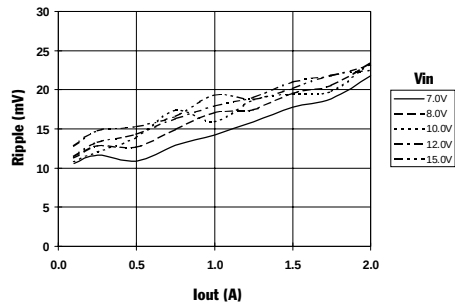
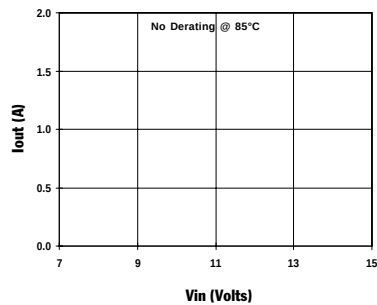
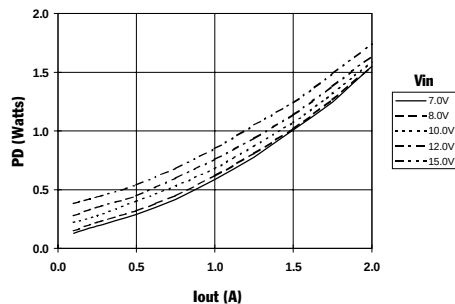
\* ISR will operate down to no load with reduced specifications.

\*\* See Thermal Derating chart.

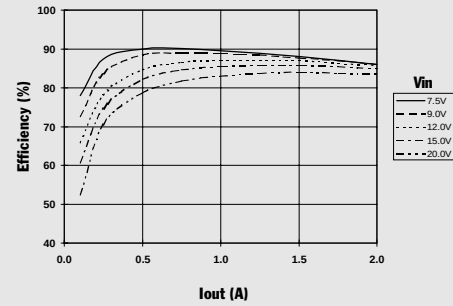
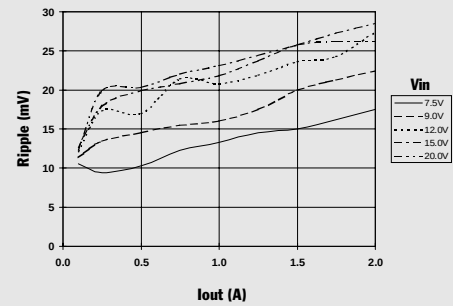
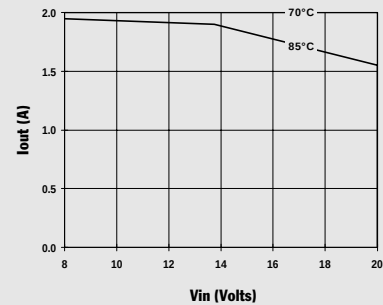
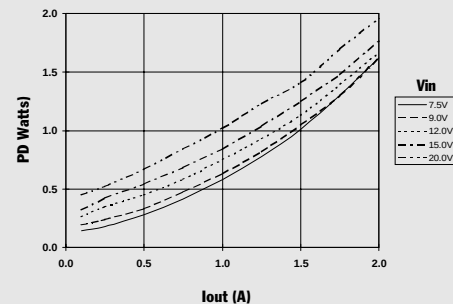
**Note:** The 78ST200 Series requires a 100 $\mu\text{F}$  electrolytic or tantalum output capacitor for proper operation in all applications.

**CHARACTERISTIC DATA****78ST200 Series****78ST233\_ 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****78ST205\_ 5.0 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 Note)

**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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 78ST205HC        | NRND                  | SIP MOD ULE  | EFA             | 3    | 25          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| 78ST205SC        | NRND                  | SIP MOD ULE  | EFC             | 3    | 25          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| 78ST205SCT       | OBSOLETE              | SIP MOD ULE  | EFC             | 3    |             | TBD                     | Call TI          | Call TI                      |
| 78ST205VC        | NRND                  | SIP MOD ULE  | EFD             | 3    | 25          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| 78ST233HC        | NRND                  | SIP MOD ULE  | EFA             | 3    | 25          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| 78ST233SC        | NRND                  | SIP MOD ULE  | EFC             | 3    | 25          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| 78ST233VC        | NRND                  | SIP MOD ULE  | EFD             | 3    | 25          | TBD                     | Call TI          | Level-1-215C-UNLIM           |
| 78ST235HC        | NRND                  | SIP MOD ULE  | EFA             | 3    |             | TBD                     | Call TI          | Call TI                      |
| 78ST235SC        | OBSOLETE              | SIP MOD ULE  | EFC             | 3    |             | TBD                     | Call TI          | Call TI                      |
| 78ST235VC        | OBSOLETE              | SIP MOD ULE  | EFD             | 3    |             | TBD                     | Call TI          | Call TI                      |

<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) 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.

**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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