

# 78ST200 Series

## 2 AMP POSITIVE STEP-DOWN INTEGRATED SWITCHING REGULATOR

Revised 6/30/98

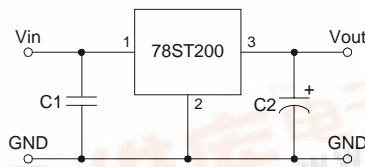


- High Efficiency > 82%
- Wide Input Range
- Self-Contained Inductor
- Short-Circuit Protection
- Over-Temperature Protection
- Fast Transient Response

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.

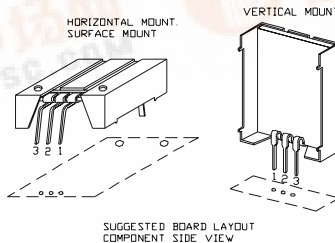
### Standard Application



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

### Pin-Out Information

Pin No.	Function
1	V <sub>in</sub>
2	GND
3	V <sub>out</sub>



### 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 (T <sub>s</sub> = 25°C unless noted)	Symbols	Conditions	78ST200 SERIES			Units
			Min	Typ	Max	
Output Current	I <sub>o</sub>	Over V <sub>in</sub> range	0.1*	—	2.0	A
Input Voltage Range	V <sub>in</sub>	I <sub>o</sub> = 0.1 to 3.0A V <sub>o</sub> < 3.5V V <sub>o</sub> = 5.0V	7 8	—	15 20	V
Output Voltage Tolerance	$\Delta$ V <sub>o</sub>	Over V <sub>in</sub> range, I <sub>o</sub> = 2.0A T <sub>a</sub> = 0°C to +60°C	—	$\pm$ 1.0	$\pm$ 2.0	%V <sub>o</sub>
Line Regulation	Reg <sub>line</sub>	Over V <sub>in</sub> range	—	$\pm$ 0.4	$\pm$ 0.8	%V <sub>o</sub>
Load Regulation	Reg <sub>load</sub>	0.1 $\leq$ I <sub>o</sub> $\leq$ 2.0A	—	$\pm$ 0.2	$\pm$ 0.4	%V <sub>o</sub>
Ripple/Noise	V <sub>n</sub>	V <sub>in</sub> = V <sub>in</sub> min, I <sub>o</sub> = 2.0A	—	1	—	%V <sub>o</sub>
Transient Response (with 100 $\mu$ F output cap)	t <sub>tr</sub>	50% load change V <sub>o</sub> over/undershoot	—	100 5.0	—	$\mu$ Sec %V <sub>o</sub>
Efficiency	$\eta$	V <sub>in</sub> = 9V, I <sub>o</sub> = 2.0A, V <sub>o</sub> = 5V	—	82	—	%
Switching Frequency	f <sub>o</sub>	Over V <sub>in</sub> and I <sub>o</sub> ranges	0.95	1.0	1.05	MHz
Absolute Maximum Operating Temperature Range	T <sub>a</sub>	—	-40	—	+85	°C
Recommended Operating Temperature Range	T <sub>a</sub>	Free Air Convection, (40-60LFM) Over V <sub>in</sub> and I <sub>o</sub> ranges	-40	—	+85**	°C
Thermal Resistance	$\theta_{ja}$	Free Air Convection, (40-60LFM)	—	38	—	°C/W
Storage Temperature	T <sub>s</sub>	—	-40	—	+125	°C
Mechanical Shock	—	Per Mil-STD-883D, Method 2002.3	—	500	—	G's
Mechanical Vibration	—	Per Mil-STD-883D, Method 2007.2, 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 $\mu$ F electrolytic or tantalum output capacitor for proper operation in all applications.



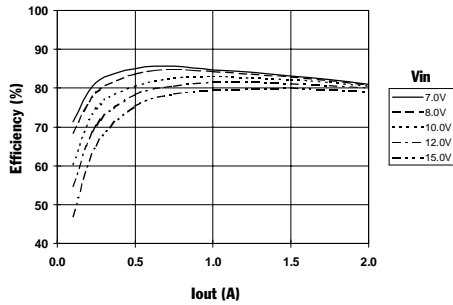
# 78ST200 Series

## CHARACTERISTIC DATA

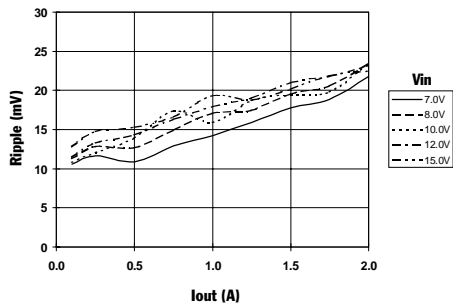
### 78ST233\_ 3.3 VDC

(See Note 1)

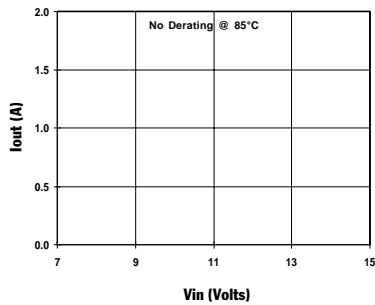
#### Efficiency vs Output Current



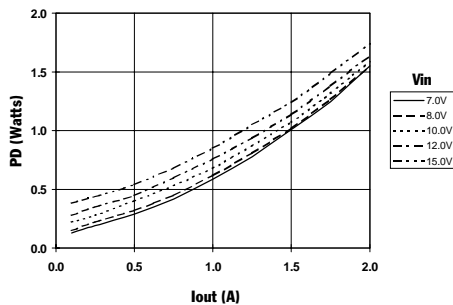
#### Ripple vs Output Current



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



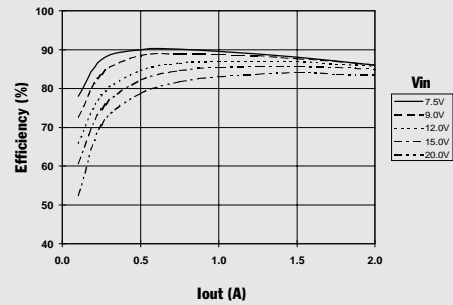
#### Power Dissipation vs Output Current



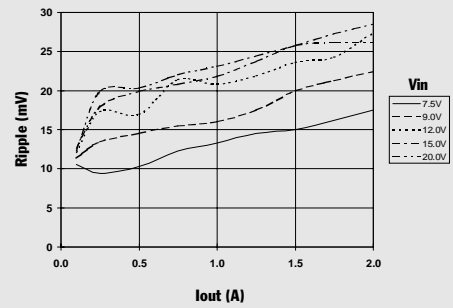
### 78ST205\_ 5.0 VDC

(See Note 1)

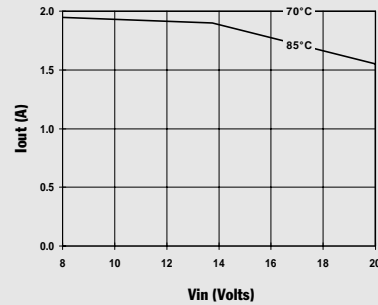
#### Efficiency vs Output Current



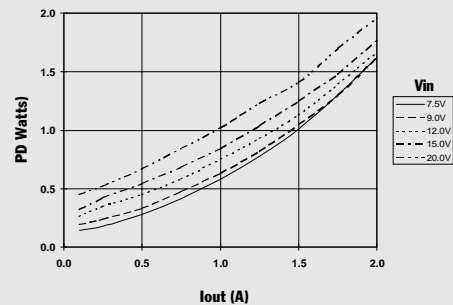
#### Ripple vs Output Current



#### 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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