

LP3853/LP3856

3A Fast Response Ultra Low Dropout Linear Regulators

General Description

The LP3853/LP3856 series of fast ultra low-dropout linear regulators operate from a +2.5V to +7.0V input supply. Wide range of preset output voltage options are available. These ultra low dropout linear regulators respond very quickly to step changes in load, which makes them suitable for low voltage microprocessor applications. The LP3853/LP3856 are developed on a CMOS process which allows low quiescent current operation independent of output load current. This CMOS process also allows the LP3853/LP3856 to operate under extremely low dropout conditions.

Dropout Voltage: Ultra low dropout voltage; typically 39mV at 300mA load current and 390mV at 3A load current.

Ground Pin Current: Typically 4mA at 3A load current.

Shutdown Mode: Typically 10nA quiescent current when the shutdown pin is pulled low.

Error Flag: Error flag goes low when the output voltage drops 10% below nominal value.

SENSE: Sense pin improves regulation at remote loads.

Precision Output Voltage: Multiple output voltage options are available ranging from 1.8V to 5.0V with a guaranteed accuracy of $\pm 1.5\%$ at room temperature, and $\pm 3.0\%$ over all conditions (varying line, load, and temperature).

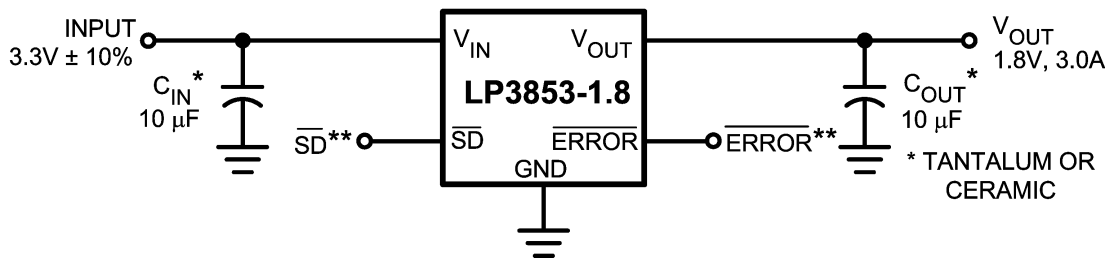
Features

- Ultra low dropout voltage
- Stable with selected ceramic capacitors
- Low ground pin current
- Load regulation of 0.08%
- 10nA quiescent current in shutdown mode
- Guaranteed output current of 3A DC
- Available in TO-263 and TO-220 packages
- Output voltage accuracy $\pm 1.5\%$
- Error flag indicates output status
- Sense option improves load regulation
- Overtemperature/overcurrent protection
- -40°C to $+125^{\circ}\text{C}$ junction temperature range

Applications

- Microprocessor power supplies
- Stable with ceramic output capacitors
- GTL, GTL+, BTL, and SSTL bus terminators
- Power supplies for DSPs
- SCSI terminator
- Post regulators
- High efficiency linear regulators
- Battery chargers
- Other battery powered applications

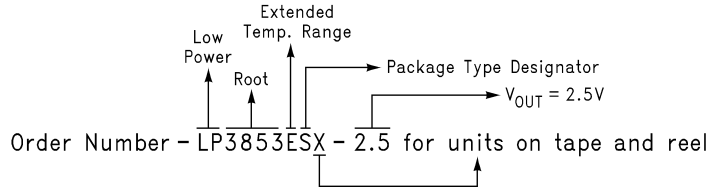
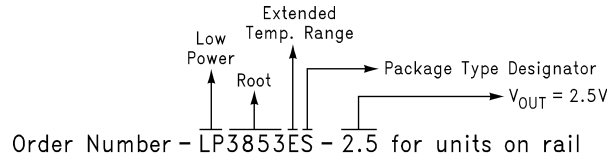
Typical Application Circuits



**SD and ERROR pins must be pulled high through a 10k Ω pull-up resistor. Connect the ERROR pin to ground if this function is not used. See Application Hints for more information.

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Ordering Information



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Package Type Designator is "T" for TO220 package, and "S" for TO263 package.

TABLE 1. Package Marking and Ordering Information

Output Voltage	Order Number	Description (Current, Option)	Package Type	Package Marking	Supplied As:
5.0	LP3853ES-5.0	3A, Error Flag	TO263-5	LP3853ES-5.0	Rail
5.0	LP3853ESX-5.0	3A, Error Flag	TO263-5	LP3853ES-5.0	Tape and Reel
3.3	LP3853ES-3.3	3A, Error Flag	TO263-5	LP3853ES-3.3	Rail
3.3	LP3853ESX-3.3	3A, Error Flag	TO263-5	LP3853ES-3.3	Tape and Reel
2.5	LP3853ES-2.5	3A, Error Flag	TO263-5	LP3853ES-2.5	Rail
2.5	LP3853ESX-2.5	3A, Error Flag	TO263-5	LP3853ES-2.5	Tape and Reel
1.8	LP3853ES-1.8	3A, Error Flag	TO263-5	LP3853ES-1.8	Rail
1.8	LP3853ESX-1.8	3A, Error Flag	TO263-5	LP3853ES-1.8	Tape and Reel
5.0	LP3856ES-5.0	3A, SENSE	TO263-5	LP3856ES-5.0	Rail
5.0	LP3856ESX-5.0	3A, SENSE	TO263-5	LP3856ES-5.0	Tape and Reel
3.3	LP3856ES-3.3	3A, SENSE	TO263-5	LP3856ES-3.3	Rail
3.3	LP3856ESX-3.3	3A, SENSE	TO263-5	LP3856ES-3.3	Tape and Reel
2.5	LP3856ES-2.5	3A, SENSE	TO263-5	LP3856ES-2.5	Rail
2.5	LP3856ESX-2.5	3A, SENSE	TO263-5	LP3856ES-2.5	Tape and Reel
1.8	LP3856ES-1.8	3A, SENSE	TO263-5	LP3856ES-1.8	Rail
1.8	LP3856ESX-1.8	3A, SENSE	TO263-5	LP3856ES-1.8	Tape and Reel
5.0	LP3853ET-5.0	3A, Error Flag	TO220-5	LP3853ET-5.0	Rail
3.3	LP3853ET-3.3	3A, Error Flag	TO220-5	LP3853ET-3.3	Rail
2.5	LP3853ET-2.5	3A, Error Flag	TO220-5	LP3853ET-2.5	Rail
1.8	LP3853ET-1.8	3A, Error Flag	TO220-5	LP3853ET-1.8	Rail
5.0	LP3856ET-5.0	3A, SENSE	TO220-5	LP3856ET-5.0	Rail
3.3	LP3856ET-3.3	3A, SENSE	TO220-5	LP3856ET-3.3	Rail
2.5	LP3856ET-2.5	3A, SENSE	TO220-5	LP3856ET-2.5	Rail
1.8	LP3856ET-1.8	3A, SENSE	TO220-5	LP3856ET-1.8	Rail

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature Range	-65°C to +150°C
Lead Temperature	
(Soldering, 5 sec.)	260°C
ESD Rating (Note 3)	2 kV
Power Dissipation (Note 2)	Internally Limited
Input Supply Voltage (Survival)	-0.3V to +7.5V
Shutdown Input Voltage (Survival)	-0.3V to 7.5V
Output Voltage (Survival), (Note 6), (Note 7)	-0.3V to +6.0V

I_{OUT} (Survival)	Short Circuit Protected
Maximum Voltage for \overline{ERROR} Pin	V_{IN}
Maximum Voltage for SENSE Pin	V_{OUT}

Operating Ratings

Input Supply Voltage (Note 11)	2.5V to 7.0V
Shutdown Input Voltage	-0.3V to 7.0V
Maximum Operating Current (DC)	3A
Junction Temperature	-40°C to +125°C

Electrical Characteristics LP3853/LP3856

Limits in standard typeface are for $T_J = 25^\circ\text{C}$, and limits in **boldface type** apply over the full operating temperature range. Unless otherwise specified: $V_{IN} = V_{O(NOM)} + 1V$, $I_L = 10\text{ mA}$, $C_{OUT} = 10\mu\text{F}$, $V_{SD} = 2V$.

Symbol	Parameter	Conditions	Typ (Note 4)	LP3853/6 (Note 5)		Units
				Min	Max	
V_O	Output Voltage Tolerance (Note 8)	$V_{OUT} + 1V \leq V_{IN} \leq 7.0V$ $10\text{ mA} \leq I_L \leq 3A$	0	-1.5 -3.0	+1.5 +3.0	%
ΔV_{OL}	Output Voltage Line Regulation (Note 8)	$V_{OUT} + 1V \leq V_{IN} \leq 7.0V$	0.02 0.06			%
$\Delta V_O / \Delta I_{OUT}$	Output Voltage Load Regulation (Note 8)	$10\text{ mA} \leq I_L \leq 3A$	0.08 0.14			%
$V_{IN} - V_{OUT}$	Dropout Voltage (Note 10)	$I_L = 300\text{ mA}$	39		50 65	mV
		$I_L = 3A$	390		450 600	
I_{GND}	Ground Pin Current In Normal Operation Mode	$I_L = 300\text{ mA}$	4		9 10	mA
		$I_L = 3A$	4		9 10	
I_{GND}	Ground Pin Current In Shutdown Mode	$V_{SD} \leq 0.3V$	0.01		10	μA
		$-40^\circ\text{C} \leq T_J \leq 85^\circ\text{C}$			50	
$I_{O(PK)}$	Peak Output Current	$V_O \geq V_{O(NOM)} - 4\%$	4.5			A
Short Circuit Protection						
I_{SC}	Short Circuit Current		6			A

Electrical Characteristics

LP3853/LP3856 (Continued)

Limits in standard typeface are for $T_J = 25^\circ\text{C}$, and limits in **boldface type** apply over the **full operating temperature range**. Unless otherwise specified: $V_{IN} = V_{O(NOM)} + 1\text{V}$, $I_L = 10\text{ mA}$, $C_{OUT} = 10\mu\text{F}$, $V_{SD} = 2\text{V}$.

Symbol	Parameter	Conditions	Typ (Note 4)	LP3853/6 (Note 5)		Units
				Min	Max	
Shutdown Input						
V_{SDT}	Shutdown Threshold	Output = High	V_{IN}	2		V
		Output = Low	0		0.3	
T_{dOFF}	Turn-off delay	$I_L = 3\text{A}$	20			μs
T_{dON}	Turn-on delay	$I_L = 3\text{A}$	25			μs
I_{SD}	$\overline{\text{SD}}$ Input Current	$V_{SD} = V_{IN}$	1			nA
Error Flag						
V_T	Threshold	(Note 9)	10	5	16	%
V_{TH}	Threshold Hysteresis	(Note 9)	5	2	8	%
$V_{EF(Sat)}$	$\overline{\text{Error}}$ Flag Saturation	$I_{\text{sink}} = 100\mu\text{A}$	0.02		0.1	V
T_d	Flag Reset Delay		1			μs
I_{lk}	$\overline{\text{Error}}$ Flag Pin Leakage Current		1			nA
I_{max}	$\overline{\text{Error}}$ Flag Pin Sink Current	$V_{\text{Error}} = 0.5\text{V}$	1			mA
AC Parameters						
PSRR	Ripple Rejection	$V_{IN} = V_{OUT} + 1\text{V}$ $C_{OUT} = 10\mu\text{F}$ $V_{OUT} = 3.3\text{V}$, $f = 120\text{Hz}$	73			dB
		$V_{IN} = V_{OUT} + 0.5\text{V}$ $C_{OUT} = 10\mu\text{F}$ $V_{OUT} = 3.3\text{V}$, $f = 120\text{Hz}$	57			
$\rho_{n(f)}$	Output Noise Density	$f = 120\text{Hz}$	0.8			μV
e_n	Output Noise Voltage	$\text{BW} = 10\text{Hz} - 100\text{kHz}$ $V_{OUT} = 2.5\text{V}$	150			$\mu\text{V (rms)}$
		$\text{BW} = 300\text{Hz} - 300\text{kHz}$ $V_{OUT} = 2.5\text{V}$	100			

Note 1: Absolute maximum ratings indicate limits beyond which damage to the device may occur. Operating ratings indicate conditions for which the device is intended to be functional, but does not guarantee specific performance limits. For guaranteed specifications and test conditions, see Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 2: At elevated temperatures, devices must be derated based on package thermal resistance. The devices in TO220 package must be derated at $\theta_{JA} = 50^\circ\text{C/W}$ (with 0.5in^2 , 1oz. copper area), junction-to-ambient (with no heat sink). The devices in the TO263 surface-mount package must be derated at $\theta_{JA} = 60^\circ\text{C/W}$ (with 0.5in^2 , 1oz. copper area), junction-to-ambient. See Application Hints.

Note 3: The human body model is a 100pF capacitor discharged through a $1.5\text{k}\Omega$ resistor into each pin.

Note 4: Typical numbers are at 25°C and represent the most likely parametric norm.

Note 5: Limits are guaranteed by testing, design, or statistical correlation.

Note 6: If used in a dual-supply system where the regulator load is returned to a negative supply, the output must be diode-clamped to ground.

Note 7: The output PMOS structure contains a diode between the V_{IN} and V_{OUT} terminals. This diode is normally reverse biased. This diode will get forward biased if the voltage at the output terminal is forced to be higher than the voltage at the input terminal. This diode can typically withstand 200mA of DC current and 1Amp of peak current.

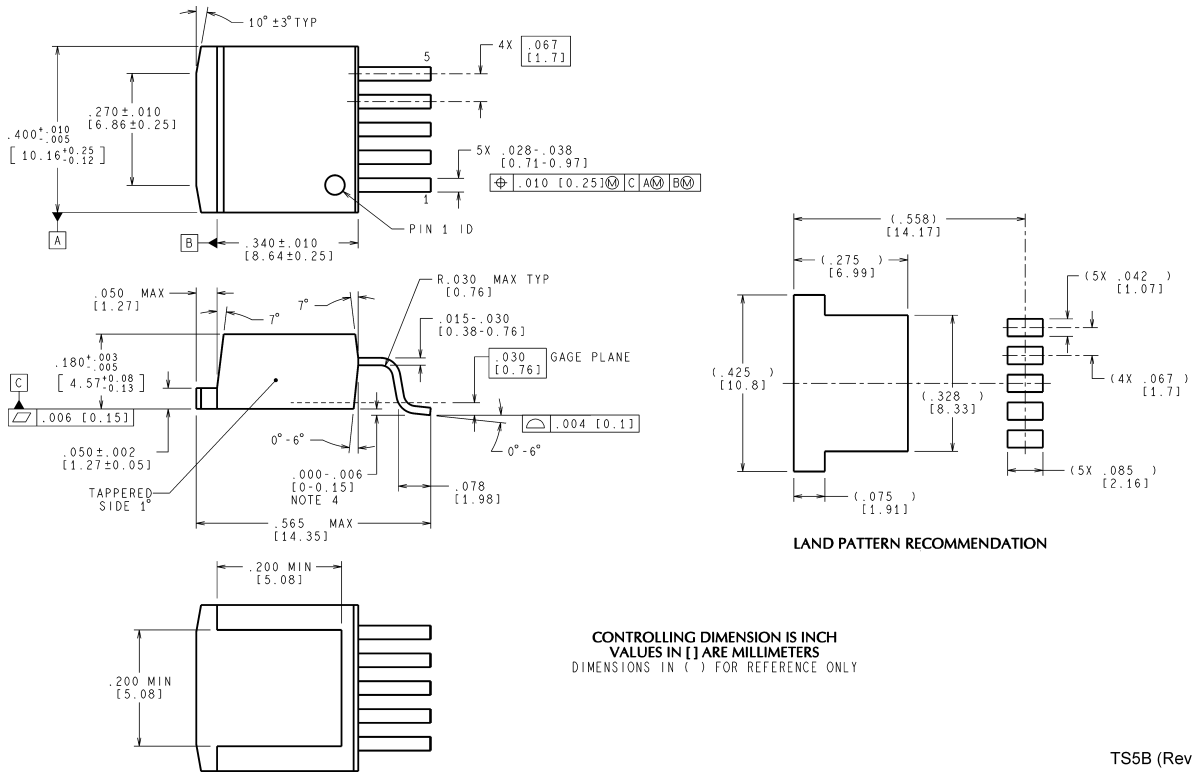
Note 8: Output voltage line regulation is defined as the change in output voltage from the nominal value due to change in the input line voltage. Output voltage load regulation is defined as the change in output voltage from the nominal value due to change in load current. The line and load regulation specification contains only the typical number. However, the limits for line and load regulation are included in the output voltage tolerance specification.

Note 9: Error Flag threshold and hysteresis are specified as percentage of regulated output voltage. See Application Hints.

Note 10: Dropout voltage is defined as the minimum input to output differential voltage at which the output drops 2% below the nominal value. Dropout voltage specification applies only to output voltages of 2.5V and above. For output voltages below 2.5V , the drop-out voltage is nothing but the input to output differential, since the minimum input voltage is 2.5V .

Note 11: The minimum operating value for V_{IN} is equal to either $[V_{OUT(NOM)} + V_{DROPOUT}]$ or 2.5V , whichever is greater.

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



**TO263 5-Lead, Molded, Surface Mount Package (TO263-5)
NS Package Number TS5B**

For Order Numbers, refer to the "Ordering Information" section of this document.

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TS5B (Rev D)

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