

## FEATURES

- Regulated 12V  $\pm$ 5% Output Voltage
- **No Inductors**
- Supply Voltage Range: 4.75V to 5.5V
- **Guaranteed 30mA Output**
- **Low Power:  $I_{CC} = 500\mu\text{A}$**
- $I_{CC}$  in Shutdown: 0.5 $\mu\text{A}$
- 8-Pin PDIP or SO-8 Package

## APPLICATIONS


- 12V Flash Memory Programming Supplies
- Compact 12V Op Amp Supplies
- Battery-Powered Systems

## DESCRIPTION

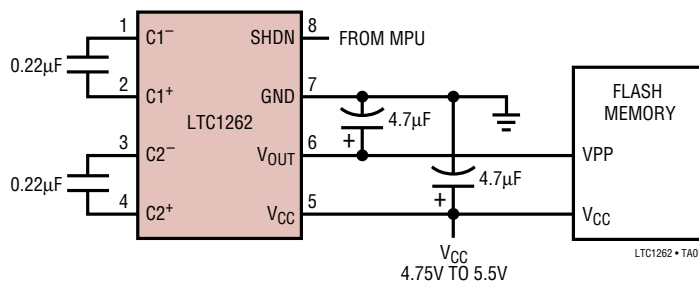
The LTC<sup>®</sup>1262 is a regulated 12V, 30mA output DC/DC converter. It is designed to provide the 12V  $\pm$ 5% output necessary to program byte-wide flash memories. The output will provide up to 30mA from input voltages as low as 4.75V without using any inductors. Only four external capacitors are required to complete an extremely small surface mountable circuit.

The TTL compatible shutdown pin can be directly connected to a microprocessor and reduces the supply current to less than 0.5 $\mu\text{A}$ . The LTC1262 offers improved shutdown current performance and requires fewer external components than competing solutions.

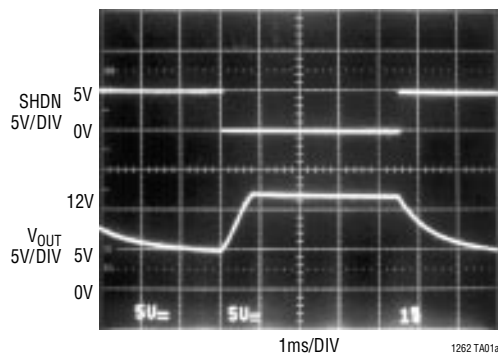
The LTC1262 is available in an 8-pin PDIP or SO-8 package.

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## TYPICAL APPLICATION



In/Out of Shutdown



## ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage ( $V_{CC}$ )	6V
Input Voltage (SHDN)	-0.3V to $V_{CC} + 0.3V$
Output Current ( $I_{OUT}$ )	50mA
Operating Temperature Range	
LTC1262C	0°C to 70°C
LTC1262I	-40°C to 85°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

## PACKAGE/ORDER INFORMATION

<p>N8 PACKAGE 8-LEAD PDIP</p> <p>S8 PACKAGE 8-LEAD PLASTIC SO</p> <p><math>T_{JMAX} = 150^{\circ}C</math>, <math>\theta_{JA} = 100^{\circ}C/W</math> (N8)  <math>T_{JMAX} = 150^{\circ}C</math>, <math>\theta_{JA} = 150^{\circ}C/W</math> (S8)</p>	ORDER PART NUMBER
	LTC1262CN8 LTC1262CS8 LTC1262IS8
	S8 PART MARKING
	1262 1262I

Consult factory for Military grade parts.

## ELECTRICAL CHARACTERISTICS

$V_{CC} = 4.75V$  to  $5.5V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$ , (Notes 2, 3), unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	
$V_{OUT}$	Output Voltage	$0mA \leq I_{OUT} \leq 30mA$ , $V_{SHDN} = 0V$ , $0^{\circ}C \leq T_A \leq 70^{\circ}C$	●	11.4	12.6	V	
		$0mA \leq I_{OUT} \leq 30mA$ , $V_{SHDN} = 0V$ , $-40^{\circ}C \leq T_A \leq 85^{\circ}C$	●	11.2	12.6	V	
$I_{CC}$	Supply Current	No Load, $V_{SHDN} = 0V$ , $0^{\circ}C \leq T_A \leq 70^{\circ}C$	●	0.5	1.0	mA	
		No Load, $V_{SHDN} = 0V$ , $-40^{\circ}C \leq T_A \leq 85^{\circ}C$	●	0.5	1.3	mA	
$I_{SHDN}$	Shutdown Supply Current	No Load, $V_{SHDN} = V_{CC}$	●	0.5	10	$\mu A$	
$f_{OSC}$	Oscillator Frequency	$V_{CC} = 5V$ , $I_{OUT} = 30mA$	●	300		kHz	
	Power Efficiency	$V_{CC} = 5V$ , $I_{OUT} = 30mA$	●	74		%	
$R_{SW}$	$V_{CC}$ to $V_{OUT}$ Switch Impedance	$V_{CC} = V_{SHDN} = 5V$ , $I_{OUT} = 0mA$	●	0.18	2	$k\Omega$	
$V_{IH}$	SHDN Input High Voltage		●	2.4		V	
$V_{IL}$	SHDN Input Low Voltage		●		0.8	V	
	SHDN Input Current	$V_{CC} = 5V$ , $V_{SHDN} = 0V$ , $0^{\circ}C \leq T_A \leq 70^{\circ}C$	●	-20	-10	-5	$\mu A$
		$V_{CC} = 5V$ , $V_{SHDN} = 0V$ , $-40^{\circ}C \leq T_A \leq 85^{\circ}C$	●	-35	-10	-5	$\mu A$
		$V_{CC} = 5V$ , $V_{SHDN} = 5V$	●		0.06	10	$\mu A$
$t_{ON}$	Turn-On Time	$C1 = C2 = 0.22\mu F$ , $C_{IN} = C_{OUT} = 4.7\mu F$ , (Figures 1, 2)		500		$\mu s$	
$t_{OFF}$	Turn-Off Time	$C1 = C2 = 0.22\mu F$ , $C_{IN} = C_{OUT} = 4.7\mu F$ , (Figures 1, 2)		3.3		ms	

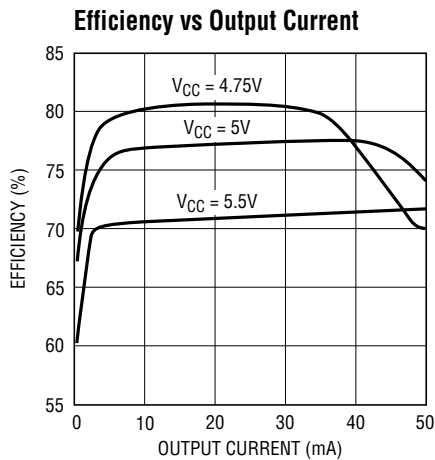
The ● denotes specifications which apply over the full operating temperature range.

**Note 1:** Absolute maximum ratings are those values beyond which the life of the device may be impaired.

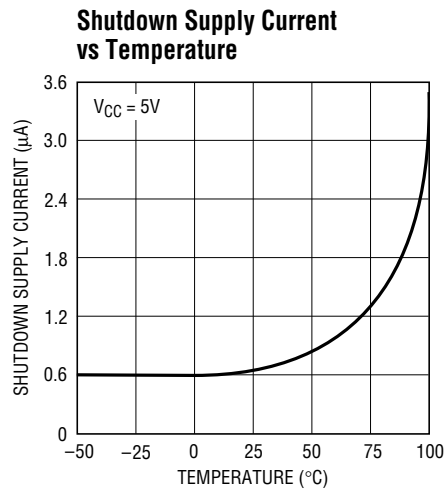
**Note 2:** All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified.

**Note 3:** All typicals are given at  $V_{CC} = 5V$ ,  $T_A = 25^{\circ}C$ .

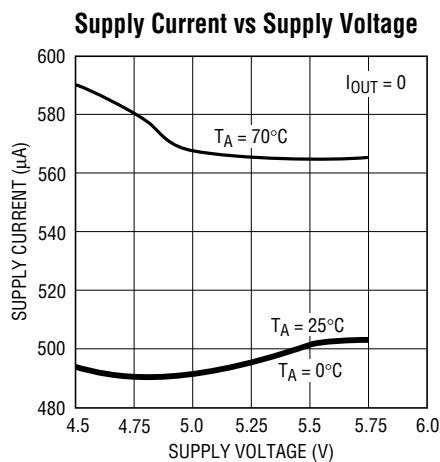
## TYPICAL PERFORMANCE CHARACTERISTICS



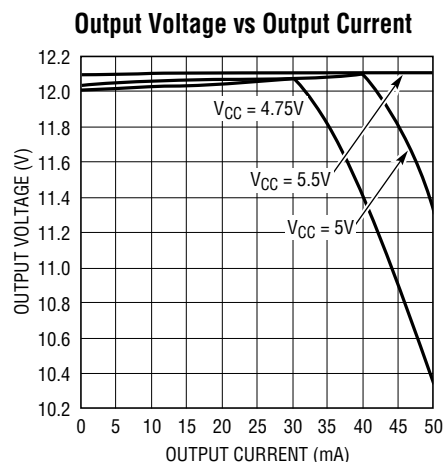
LTC1262 G01



LTC1262 G02



LTC1262 G03



1262 G04

## PIN FUNCTIONS

**C1<sup>-</sup> (Pin 1):** C1 Negative Input. Connect a 0.22µF capacitor C1 between C1<sup>+</sup> and C1<sup>-</sup>.

**C1<sup>+</sup> (Pin 2):** C1 Positive Input. Connect a 0.22µF capacitor C1 between C1<sup>+</sup> and C1<sup>-</sup>.

**C2<sup>-</sup> (Pin 3):** C2 Negative Input. Connect a 0.22µF capacitor C2 between C2<sup>+</sup> and C2<sup>-</sup>.

**C2<sup>+</sup> (Pin 4):** C2 Positive Input. Connect a 0.22µF capacitor C2 between C2<sup>+</sup> and C2<sup>-</sup>.

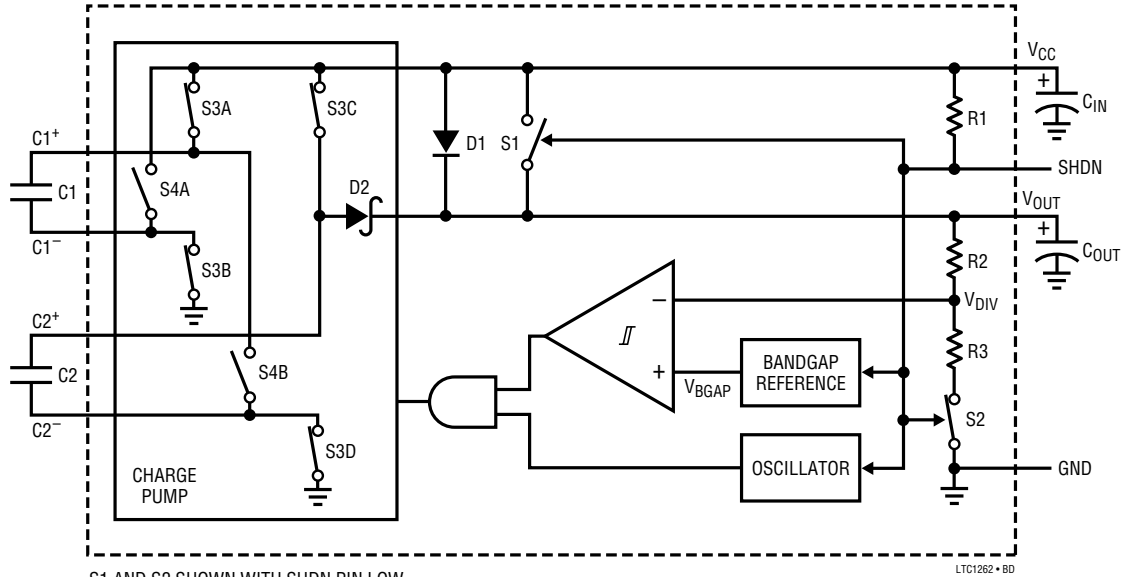
**V<sub>CC</sub> (Pin 5):** Positive Supply Input Where  $4.75V \leq V_{CC} \leq 5.5V$ . Connect a 4.7µF bypass capacitor C<sub>IN</sub> to ground.

**V<sub>OUT</sub> (Pin 6):** 12V Output. Connect a 4.7µF bypass capacitor C<sub>OUT</sub> to ground. When in the shutdown mode  $V_{OUT} = V_{CC}$ .

**GND (Pin 7):** Ground.

**SHDN (Pin 8):** Logic Level Shutdown Pin. Application of a logic low at SHDN pin will place the regulator in normal operation. With no external connection, or with SHDN tied to V<sub>CC</sub>, the device will be put into shutdown mode. Connect to GND for normal operation. In shutdown mode the charge pump is turned off and  $V_{OUT} = V_{CC}$ .

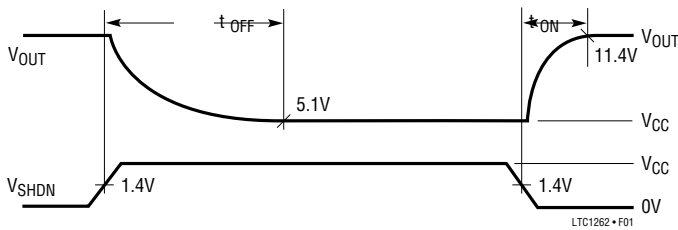
# BLOCK DIAGRAM



S1 AND S2 SHOWN WITH SHDN PIN LOW.  
 S3A, S3B, S3C, S3D, S4A AND S4B SHOWN WITH OSCILLATOR OUTPUT LOW AND  $V_{DIV} < V_{BGAP} - V_{HYST}$ .  
 COMPARATOR HYSTERISIS IS  $\pm V_{HYST}$ .

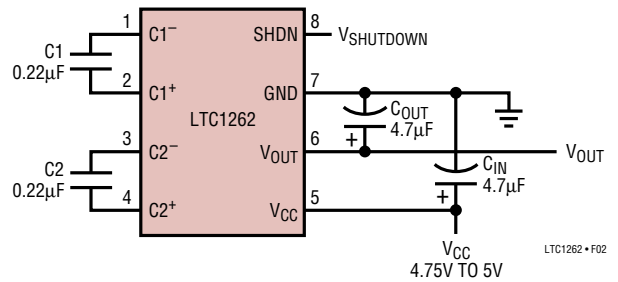
LTC1262 • BD

# TIMING DIAGRAMS



LTC1262 • F01

Figure 1. LTC1262 Timing Diagram



LTC1262 • F02

Figure 2. LTC1262 Timing Circuit

## APPLICATIONS INFORMATION

### Operation

The LTC1262 uses a charge pump tripler to generate 12V from a  $V_{CC}$  of 5V. The charge pump operates when clocked by a 300kHz oscillator. When the oscillator output is low, C1 and C2 are connected between  $V_{CC}$  and GND, charging them to  $V_{CC}$ . When the oscillator output goes high, C1 and C2 are stacked in series with the bottom plate of C1 pulled to  $V_{CC}$ . The top plate of C2 is switched to charge  $C_{OUT}$  and  $V_{OUT}$  rises.  $V_{OUT}$  is regulated to within 5% of 12V by an oscillator pulse gating scheme. A resistor divider senses  $V_{OUT}$ . When the output of the divider ( $V_{DIV}$ ) is less than the output of a bandgap ( $V_{BGAP}$ ) by the hysteresis voltage ( $V_{HYST}$ ) of the comparator, oscillator pulses are applied to the charge pump to raise  $V_{OUT}$ . When  $V_{DIV}$  is above  $V_{BGAP}$  by  $V_{HYST}$ , the oscillator pulses are prevented from clocking the charge pump.  $V_{OUT}$  drops until  $V_{DIV}$  is below  $V_{BGAP}$  by  $V_{HYST}$  again. The gates of all internal switches are driven between  $V_{OUT}$  and GND. An internal diode ensures that the LTC1262 will start up under load by charging  $C_{OUT}$  to one diode drop below  $V_{CC}$ .

To reduce supply current the LTC1262 may be put into shutdown mode by floating the SHDN pin or taking it to  $V_{CC}$ . In this mode the bandgap, comparator, oscillator and resistor divider are switched off to reduce supply current to typically 0.5 $\mu$ A. At the same time an internal switch shorts  $V_{OUT}$  to  $V_{CC}$ ;  $V_{OUT}$  takes 3.3ms to reach 5.1V (see  $t_{OFF}$  in Figure 1). When the SHDN pin is low, the LTC1262 exits shutdown and the charge pump operates to raise  $V_{OUT}$  to 12V.  $V_{OUT}$  takes 500 $\mu$ s to reach the lower regulation limit of 11.4V (see  $t_{ON}$  in Figure 1).

### Choice of Capacitors

The LTC1262 is tested with the capacitors shown in Figure 2. C1 and C2 are 0.22 $\mu$ F ceramic capacitors and  $C_{IN}$  and  $C_{OUT}$  are 4.7 $\mu$ F tantalum capacitors. Refer to Table 1 if other choices are desired.

**Table 1. Recommended Capacitor Types and Values**

CAPACITOR	CERAMIC	TANTALUM	ALUMINUM
C1, C2	0.22 $\mu$ F to 1 $\mu$ F	Not Recommended	Not Recommended
$C_{OUT}$	2 $\mu$ F (Min)	4.7 $\mu$ F (Min)	10 $\mu$ F (Min)
$C_{IN}$	1 $\mu$ F (Min)	4.7 $\mu$ F (Min)	10 $\mu$ F (Min)

C1 and C2 should be ceramic capacitors with values in the range of 0.22 $\mu$ F to 1 $\mu$ F. Higher values provide better load regulation. Tantalum capacitors are not recommended as the higher ESR of these capacitors degrades performance when the load current is above 25mA with  $V_{CC} = 4.75$ V.

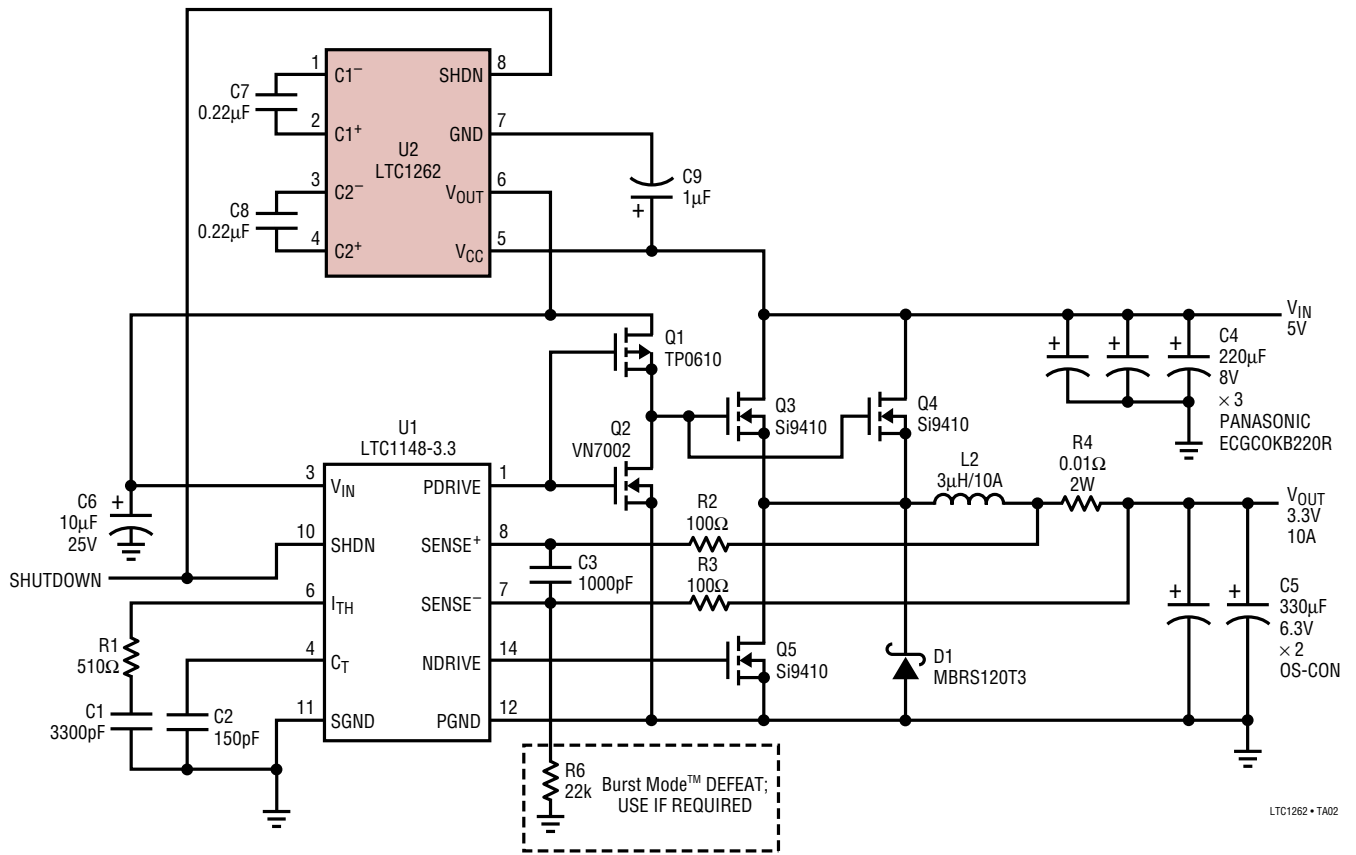
$C_{IN}$  and  $C_{OUT}$  can be ceramic, tantalum or electrolytic capacitors. The ESR of  $C_{OUT}$  introduces steps in the  $V_{OUT}$  waveform whenever the charge pump charges  $C_{OUT}$ . This tends to increase  $V_{OUT}$  ripple. Ceramic or tantalum capacitors are recommended for  $C_{OUT}$  if minimum ripple is desired. The LTC1262 does not require a 0.1 $\mu$ F capacitor between  $V_{CC}$  and  $V_{OUT}$  for stability.

### Maximum Load Current

The LTC1262 will source up to 50mA continuously without any damage to itself. **Do not short the  $V_{OUT}$  pin to ground.** If the  $V_{OUT}$  pin is shorted to ground, irreversible damage to the device will result.

TYPICAL APPLICATION

5V to 3.3V/10A Converter

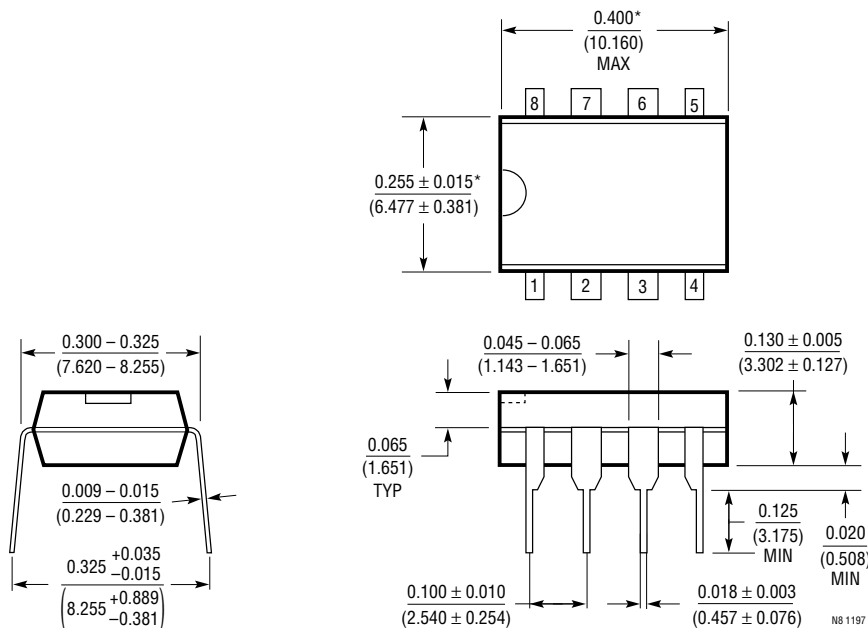


LTC1262 • TA02

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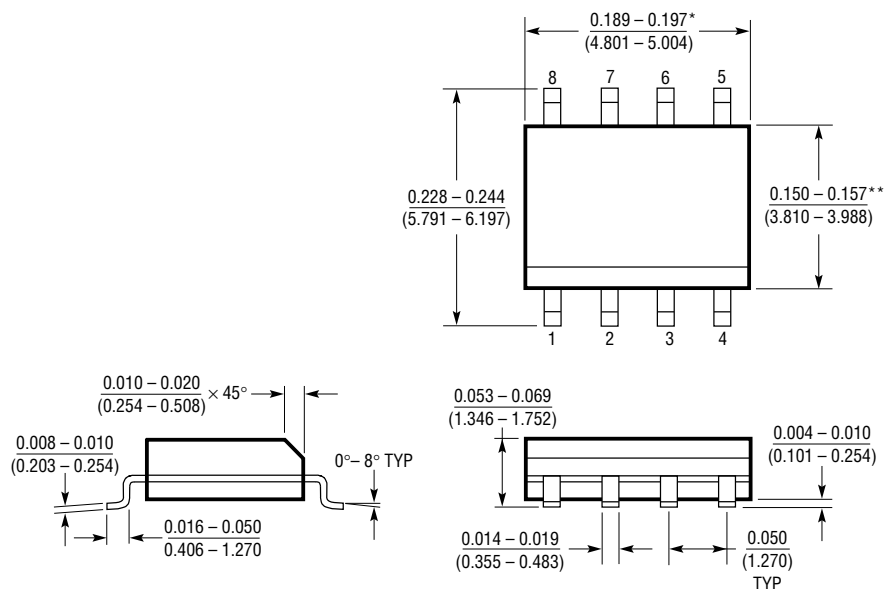
**PACKAGE DESCRIPTION** Dimensions in inches (millimeters) unless otherwise noted.

**N8 Package**  
**8-Lead PDIP (Narrow 0.300)**  
 (LTC DWG # 05-08-1510)



\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
 MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

**S8 Package**  
**8-Lead Plastic Small Outline (Narrow 0.150)**  
 (LTC DWG # 05-08-1610)



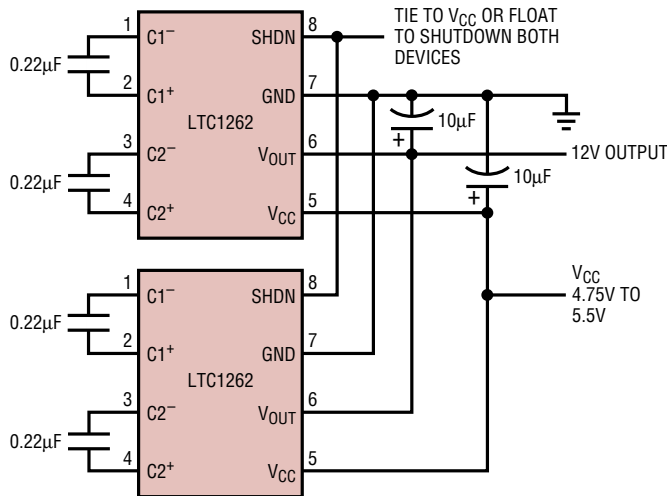
\*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

\*\*DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

S08 0996

## TYPICAL APPLICATION

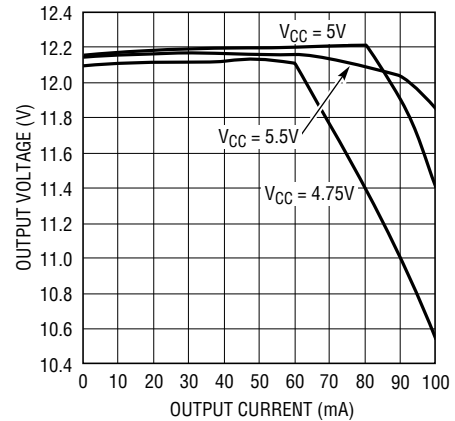
### Paralleling Devices



**NOTE:** KEEP DEVICES CLOSE TOGETHER OR USE SEPARATE 4.7µF TANTALUM CAPACITORS IF THIS IS NOT POSSIBLE.

LTC1262 • TA03

### Output Voltage vs Output Current for Two Paralleled Devices



SEE FIGURE AT LEFT.

## RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1106*	Micropower Step-Up DC/DC Converter for PCMCIA Card Flash Memory	PCMCIA Card Power Control, 9µA $I_{SHDN}$ , Small SMT Components, Requires External Inductor
LT1109-12	Micropower Low Cost DC/DC Converter Adjustable and Fixed 12V	Three-Lead Z Package, Requires External Inductor
LT1109A-12	Micropower DC/DC Converter Flash Memory VPP Generator Adjustable and Fixed 12V	Requires External Inductor
LT1301	Micropower High Efficiency 5V/12V Step-Up DC/DC Converter for Flash Memory	7µA $I_{SHDN}$ , SMT Inductor and Capacitors
LT1309	500kHz Micropower DC/DC Converter for Flash Memory	Small SMT Inductor and Capacitors, 6µA $I_{SHDN}$

\* See also LT1312/LT1313 PCMCIA VPP drivers/regulators, LT1314/LT1315 PCMCIA switch matrix and the LTC1470/LTC1471/LTC1472 Protected  $V_{CC}$  and VPP switching matrices