

FEATURES

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

APPLICATIONS


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

DESCRIPTION

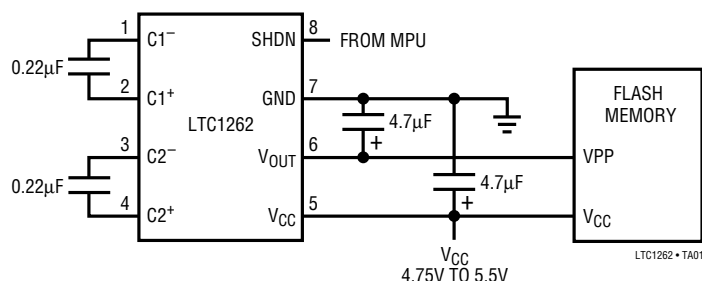
The LTC[®]1262 is a regulated 12V, 30mA output DC/DC converter. It is designed to provide the 12V $\pm 5\%$ output necessary to program byte-wide flash memories. The output will provide up to 30mA from input voltages as low as 4.75V without using any inductors. Only four external capacitors are required 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 $0.5\mu A$. The LTC1262 offers improved shutdown current performance and requires fewer external components than competing solutions.

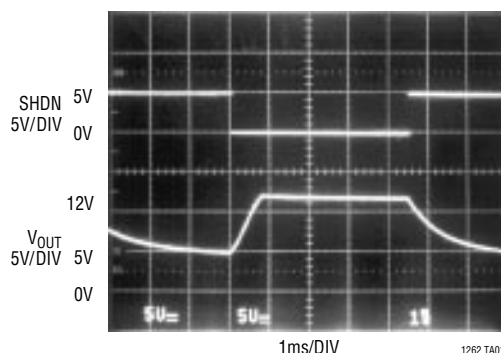
The LTC1262 is available in an 8-pin PDIP or SO-8 package.

 and LTC are registered trademarks and LT is a trademark of Linear Technology Corporation.

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	$0^{\circ}C$ to $70^{\circ}C$
Storage Temperature Range	$-65^{\circ}C$ to $150^{\circ}C$
Lead Temperature (Soldering, 10 sec)	$300^{\circ}C$

PACKAGE/ORDER INFORMATION

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

Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS $V_{CC} = 4.75V$ to $5.5V$, $T_A = 0^{\circ}C$ to $70^{\circ}C$, (Notes 2, 3), unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{OUT}	Output Voltage	$0mA \leq I_{OUT} \leq 30mA$, $V_{SHDN} = 0V$	11.4		12.6	V
I_{CC}	Supply Current	No Load, $V_{SHDN} = 0V$		0.5	1	mA
I_{SHDN}	Shutdown Supply Current	No Load, $V_{SHDN} = V_{CC}$		0.5	10	μA
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	$V_{CC} = 5V$, $V_{SHDN} = 0V$	-20	-10	-5	μA
		$V_{CC} = 5V$, $V_{SHDN} = 5V$		0.06	10	μA
t_{ON}	Turn-On Time	$C1 = C2 = 0.22\mu F$, $C_{IN} = C_{OUT} = 4.7\mu F$, (Figures 1, 2)		500		μs
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

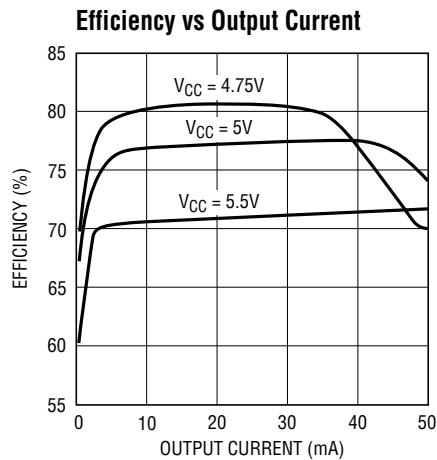
The ● denotes specifications which apply over the full operating temperature range.

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

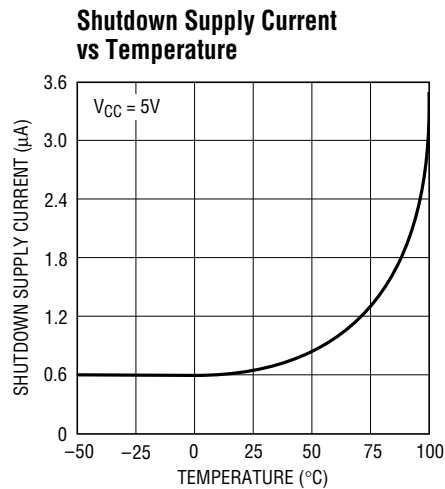
Note 2: All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified.

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

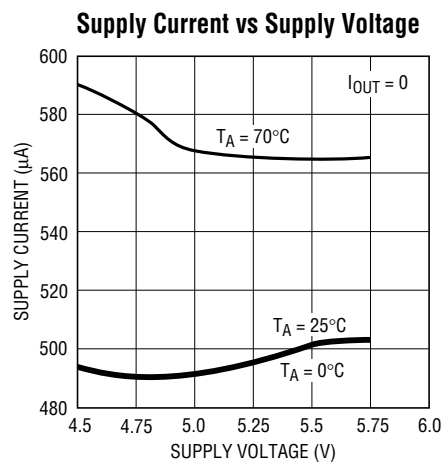
TYPICAL PERFORMANCE CHARACTERISTICS



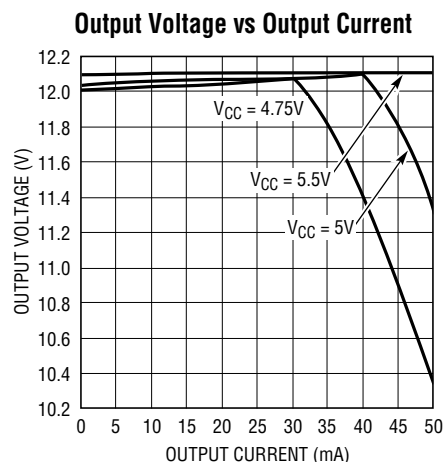
LTC1262 G01



LTC1262 G02



LTC1262 G03



1262 G04

PIN FUNCTIONS

C1⁻ (Pin 1): C1 Negative Input. Connect a 0.22µF capacitor C1 between C1⁺ and C1⁻.

C1⁺ (Pin 2): C1 Positive Input. Connect a 0.22µF capacitor C1 between C1⁺ and C1⁻.

C2⁻ (Pin 3): C2 Negative Input. Connect a 0.22µF capacitor C2 between C2⁺ and C2⁻.

C2⁺ (Pin 4): C2 Positive Input. Connect a 0.22µF capacitor C2 between C2⁺ and C2⁻.

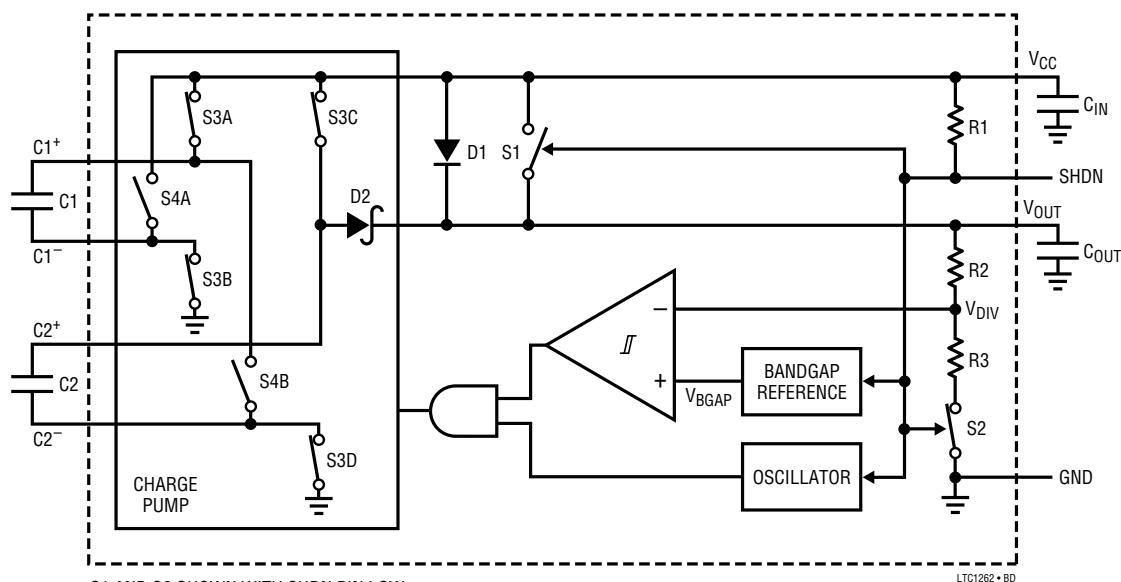
V_{CC} (Pin 5): Positive Supply Input Where 4.75V ≤ V_{CC} ≤ 5.5V. Connect a 4.7µF bypass capacitor C_{IN} to ground.

V_{OUT} (Pin 6): 12V Output. Connect a 4.7µF bypass capacitor C_{OUT} 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_{CC}, 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 $\pm V_{HYST}$.

TIMING DIAGRAMS

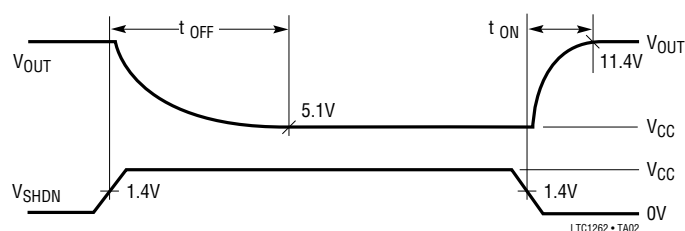


Figure 1. LTC1262 Timing Diagram

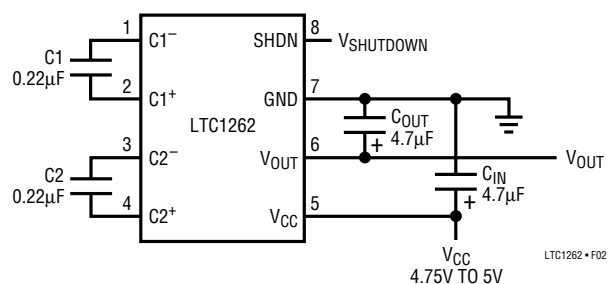


Figure 2. LTC1262 Timing Circuit

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 μ 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 μ 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 μ F ceramic capacitors and C_{IN} and C_{OUT} are 4.7 μ 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 μ F to 1 μ F	Not Recommended	Not Recommended
C_{OUT}	2 μ F (Min)	4.7 μ F (Min)	10 μ F (Min)
C_{IN}	1 μ F (Min)	4.7 μ F (Min)	10 μ F (Min)

C1 and C2 should be ceramic capacitors with values in the range of 0.22 μ F to 1 μ 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 μ 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.

[illegible]

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

Figure 10 is a line graph showing the load regulation of the circuit. The y-axis represents the Output Voltage in Volts (V), ranging from 10.4 to 12.4 with major grid lines every 0.2 V and minor grid lines every 0.02 V. The x-axis represents the Output Current in milliamperes (mA), ranging from 0 to 100 with major grid lines every 10 mA and minor grid lines every 2 mA. Three curves are plotted for different input voltages (V_{CC}):

- $V_{CC} = 5V$: This curve starts at approximately 12.15 V at 0 mA, remains relatively flat until about 60 mA, and then drops sharply to about 11.4 V at 100 mA.
- $V_{CC} = 5.5V$: This curve starts at approximately 12.18 V at 0 mA, remains flat until about 60 mA, and then drops to about 11.8 V at 100 mA.
- $V_{CC} = 4.75V$: This curve starts at approximately 12.12 V at 0 mA, remains flat until about 60 mA, and then drops to about 10.6 V at 100 mA.

The graph illustrates that the output voltage is highly dependent on the input voltage and the output current. For a given input voltage, the output voltage is relatively constant for low currents but drops significantly as the current increases, especially for lower input voltages.

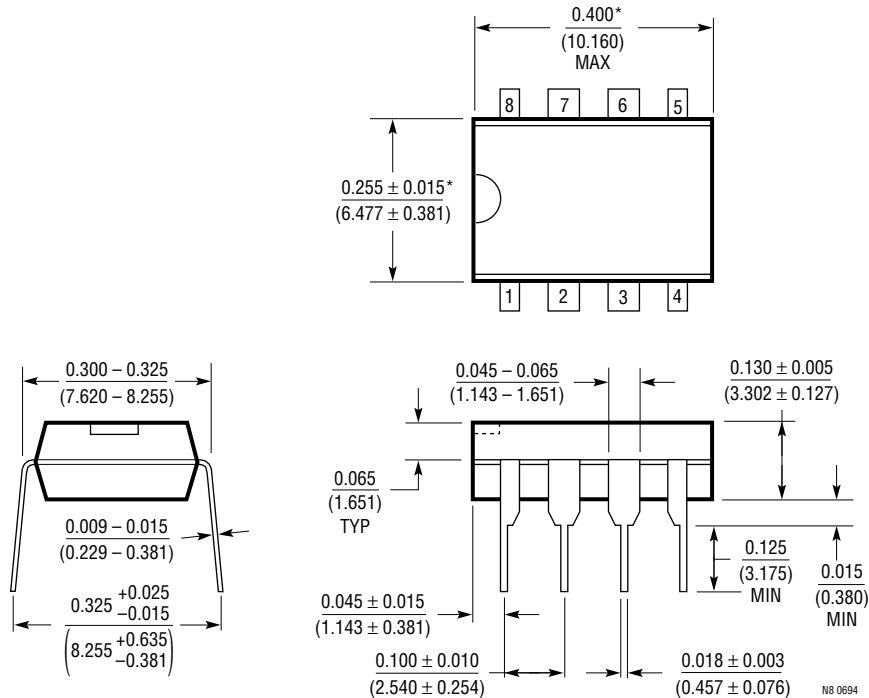
1262 TA04

Burst Mode is a trademark of Linear Technology Corporation.

PACKAGE DESCRIPTION

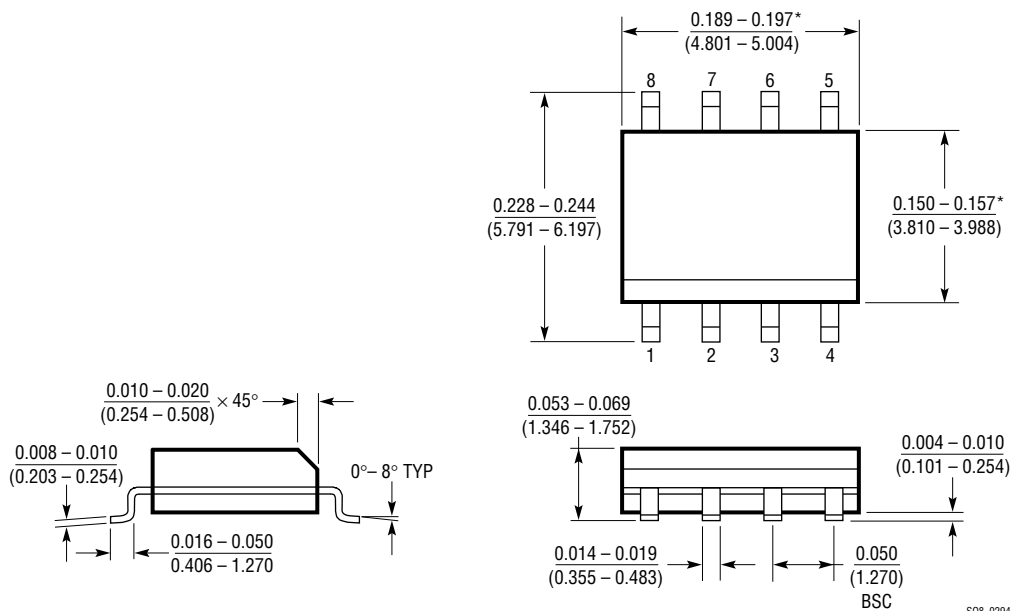
Dimensions in inches (millimeters) unless otherwise noted.

N8 Package 8-Lead Plastic DIP



*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 SOIC



*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 INCH (0.15mm).

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1106*	Micropower Step-Up DC/DC Converter for PCMCIA Card Flash Memory	PCMCIA Card Power Control, 9 μ A 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	7 μ A I_{SHDN} , SMT Inductor and Capacitors
LT1309	500kHz Micropower DC/DC Converter for Flash Memory	Small SMT Inductor and Capacitors, 6 μ A 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