

Switched-Capacitor Voltage Inverter with Shutdown

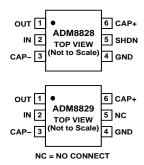
ADM8828/ADM8829

FEATURES

Inverts Input Supply Voltage 99% Voltage Conversion Efficiency 25 mA Output Current Shutdown Function Requires Only Two Capacitors 1 μ F Capacitors 18 Ω Output Resistance +1.5 V to +5.5 V Input Range 600 μ A Quiescent Current 20 nA Shutdown Current (ADM8828)

APPLICATIONS
Handheld Instruments
LCD Panels
Cellular Phones
PDAs
Remote Data Acquisition
Op Amp Power Supplies

FUNCTIONAL BLOCK DIAGRAMS



GENERAL DESCRIPTION

The ADM8828/ADM8829 is a charge-pump voltage inverter which may be used to generate a negative supply from a positive input. Input voltages ranging from +1.5 V to +5.5 V can be inverted into a negative -1.5 V to -5.5 V output supply. This inverting scheme is ideal for generating a negative rail in single power-supply systems. Only two small external capacitors are needed for the charge pump. Output currents up to 25 mA with greater than 99% efficiency are achievable.

The ADM8828 also features a low power shutdown (SHDN) pin. This can be used to disable the device and reduce the quiescent current to 20 nA.

The ADM8828/ADM8829 is available in a 6-lead SOT-23 package.

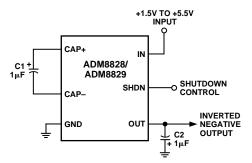


Figure 1. Typical Circuit Configuration

REV. A

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices.

$\textbf{ADM8828/ADM8829} \textbf{—SPECIFICATIONS} \stackrel{(V_{IN} \ = \ +5\ V,\ C1,\ C2 \ = \ 1\ \mu F,\ ^1\ T_A \ = \ T_{MIN}\ to\ T_{MAX}\ unless\ otherwise\ noted)}$

Parameter	Min	Тур	Max	Units	Test Conditions/Comments	
Input Voltage, IN	1.5		5.5	V	$R_L = 10 \text{ k}\Omega$	
Supply Current		600	1000	μΑ	Unloaded	
Output Current Output Resistance Output Ripple	25	18 25 130	28	mA Ω mV p-p mV p-p	$I_L = 5 \text{ mA}$ $I_L = 5 \text{ mA}$ $I_L = 25 \text{ mA}$	
Charge-Pump Frequency	50 65	120	190	kHz kHz	V _{IN} = +2.25 V	
Power Efficiency Voltage Conversion Efficiency	99.5	90 87 99.96 98 91		% % % %	$R_L = 200 \ \Omega$ $R_L = 1 \ k\Omega$ No Load $R_L = 1 \ k\Omega$ $R_L = 200 \ \Omega$	
Shutdown Supply Current, I_{SHDN} Shutdown Input Voltage, V_{SHDN} Shutdown Exit Time	2.0	0.02 175	2 0.8	μΑ V V μs	SHDN = IN SHDN High = Disabled SHDN Low = Enabled $I_L = 5 \text{ mA}$	

NOTES

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS*

 $(T_A = +25^{\circ}C \text{ unless otherwise noted})$

Input Voltage (IN to GND) $-0.3~V$ to +6 V
OUT to GND
OUT, IN Output Current (Continuous) 50 mA
Output Short Circuit Duration to GND 10 secs
Power Dissipation, RT-6 570 mW
(Derate 8.3 mW/°C above +70°C)
θ_{JA} , Thermal Impedance
Operating Temperature Range
Industrial (A Version)40°C to +85°C
Storage Temperature Range65°C to +150°C
Lead Temperature Range (Soldering 10 sec) +300°C
Vapor Phase (70 sec) +215°C
Infrared (15 sec) +220°C
ESD Rating>3500 V

^{*}This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ORDERING GUIDE

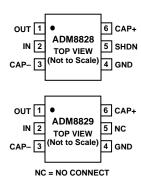
Model	Temperature	Branding	Package
	Range	Information	Option*
	-40°C to +85°C	MM0	RT-6
	-40°C to +85°C	MN0	RT-6

^{*}RT-6 = 6-lead SOT-23.

PIN FUNCTION DESCRIPTIONS

Mnemonic	Function
CAP+	Positive Charge-Pump Capacitor Terminal.
GND	Power Supply Ground.
CAP-	Negative Charge-Pump Capacitor Terminal.
OUT	Output, Negative Voltage.
SHDN	Shutdown Control Input. This input, when high, is used to disable the charge pump thereby reducing the power consumption.
IN	Positive Power Supply Input.

PIN CONFIGURATIONS



-2- REV. A

 $^{^{1}}$ C1 and C2 are low ESR (<0.2 Ω) electrolytic capacitors. High ESR will degrade performance.

Typical Performance Characteristics—ADM8828/ADM8829

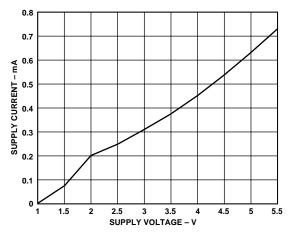


Figure 2. Power Supply Current vs. Voltage

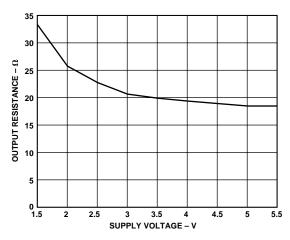


Figure 3. Output Source Resistance vs. Supply Voltage

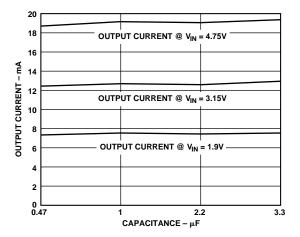


Figure 4. Output Current vs. Capacitance

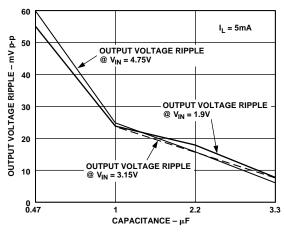


Figure 5. Output Voltage Ripple vs. Capacitance

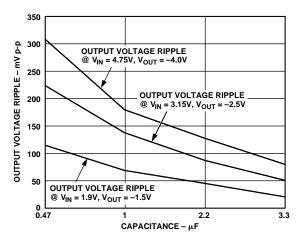


Figure 6. Output Voltage Ripple vs. Capacitance

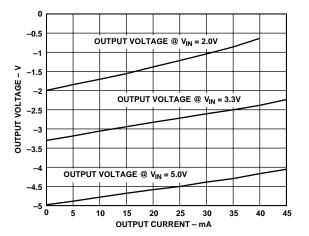


Figure 7. Output Voltage vs. Output Current

REV. A -3-

ADM8828/ADM8829

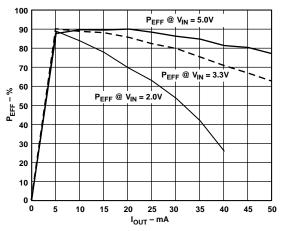


Figure 8. Power Efficiency vs. Output Current

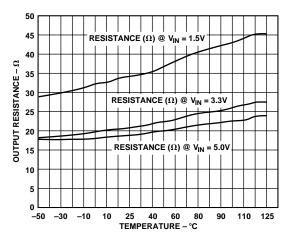


Figure 9. Output Resistance vs. Temperature

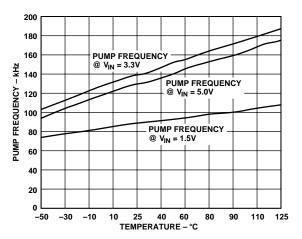


Figure 10. Charge Pump Frequency vs. Temperature

-4- REV. A

ADM8828/ADM8829

GENERAL INFORMATION

The ADM8828/ADM8829 is a switched capacitor voltage converter that can be used to invert the input supply voltage.

The voltage conversion task is achieved using a switched capacitor technique using two external charge storage capacitors. An on-chip oscillator and switching network transfers charge between the charge storage capacitors. The basic principle behind the voltage conversion scheme is illustrated below.

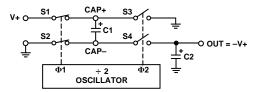


Figure 11. Voltage Inversion Principle

An oscillator generating antiphase signals $\phi 1$ and $\phi 2$ controls switches S1, S2 and S3, S4. During $\phi 1$, switches S1 and S2 are closed while S3 and S4 are open, thereby charging C1 up to the voltage at V+. During $\phi 2$, S1 and S2 open and S3 and S4 close. The positive terminal of C1 is connected to GND via S3 during this phase and the negative terminal of C1 connects to V_{OUT} via S4. The net result is voltage inversion at V_{OUT} wrt GND. Charge on C1 is transferred to C2 during $\phi 2$. Capacitor C2 maintains this voltage during $\phi 1$. The charge transfer efficiency depends on the on-resistance of the switches, the frequency at which they are being switched and also on the equivalent series resistance (ESR) of the external capacitors. For maximum efficiency, capacitors with low ESR are, therefore, recommended.

Shutdown Input

The ADM8828 contains a shutdown input that can be used to disable the device and hence reduce the power consumption. A logic high level on the SHDN input shuts the device down reducing the quiescent current to 0.02 $\mu A.$ During shutdown the output voltage discharges to 0 V. Therefore, ground referenced loads are not powered during this state. When exiting shutdown, it takes several cycles (approximately 175 μs) for the charge pump to reach its final value. If the shutdown function is not being used, SHDN should be hardwired to GND.

Capacitor Selection

The flying capacitor C1 can be increased to reduce the output resistance.

The output capacitor size C2 affects the output ripple. Increasing the capacitor size reduces the peak-peak ripple. The ESR affects both the output impedance and the output ripple.

Reducing the ESR reduces the output impedance and ripple. For convenience it is recommended that both C1 and C2 be the same value.

The ac impedance of the ADM8828/ADM8829 may be reduced by using a bypass capacitor on the input supply. This capacitor should be connected between the input supply and GND. It will provide instantaneous current surges as required. Suitable capacitors of 1 μF or greater may be used.

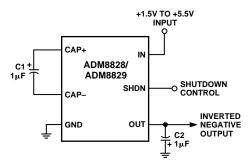


Figure 12. Typical Circuit Configuration

REV. A -5-

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

6-Lead SOT-23 (RT-6)

