FUNCTIONAL BLOCK DIAGRAMS

OUT 1
IN 2
CAP+ 3
CAP– 4
SHDN 5
GND 6
ADM8828
ADM8829

OUT 1
IN 2
CAP+ 3
CAP– 4
NC 5
GND 6
ADM8829
ADM8829

NC = NO CONNECT

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

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

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
ADM8828/ADM8829—SPECIFICATIONS (VIN = +5 V, C1, C2 = 1 µF; TA = TMIN to TMAX unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Test Conditions/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage, IN</td>
<td>1.5</td>
<td>5.5</td>
<td>V</td>
<td>RL = 10 kΩ</td>
<td></td>
</tr>
<tr>
<td>Supply Current</td>
<td>600</td>
<td>1000</td>
<td>µA</td>
<td>Unloaded</td>
<td></td>
</tr>
<tr>
<td>Output Current</td>
<td>25</td>
<td></td>
<td>mA</td>
<td>IL = 5 mA</td>
<td></td>
</tr>
<tr>
<td>Output Resistance</td>
<td>18</td>
<td>28</td>
<td>Ω</td>
<td>IL = 5 mA</td>
<td></td>
</tr>
<tr>
<td>Output Ripple</td>
<td>25</td>
<td>130</td>
<td>mV p-p</td>
<td>IL = 25 mA</td>
<td></td>
</tr>
<tr>
<td>Charge-Pump Frequency</td>
<td>50</td>
<td>120</td>
<td>kHz</td>
<td>V IN = +2.25 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65</td>
<td></td>
<td>kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Efficiency</td>
<td>90</td>
<td>97</td>
<td>%</td>
<td>RL = 200 Ω</td>
<td></td>
</tr>
<tr>
<td>Voltage Conversion Efficiency</td>
<td>99.5</td>
<td>99.96</td>
<td>%</td>
<td>RL = 1 kΩ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>98</td>
<td>91</td>
<td>%</td>
<td>RL = 1 kΩ</td>
<td></td>
</tr>
<tr>
<td>Shutdown Supply Current, I SHDN</td>
<td>2.0</td>
<td>0.02</td>
<td>µA</td>
<td>SHDN = IN</td>
<td></td>
</tr>
<tr>
<td>Shutdown Input Voltage, V SHDN</td>
<td>2.0</td>
<td>0.8</td>
<td>V</td>
<td>SHDN High = Disabled</td>
<td></td>
</tr>
<tr>
<td>Shutdown Exit Time</td>
<td>175</td>
<td></td>
<td>µs</td>
<td>I L = 5 mA</td>
<td></td>
</tr>
</tbody>
</table>

NOTES
1C1 and C2 are low ESR (<0.2 Ω) electrolytic capacitors. High ESR will degrade performance.
Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS* (TA = +25°C unless otherwise noted)

Input Voltage (IN to GND) ................. –0.3 V to +6 V
OUT to GND .................................. –6.0 V to +0.3 V
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)
θJA, Thermal Impedance ................. 120°C/W
Operating Temperature Range
Industrial (A Version) ................. –40°C to +85°C
Storage Temperature Range ................. –65°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.

PIN FUNCTION DESCRIPTIONS

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

PIN CONFIGURATIONS

[Diagram of pin configuration]

NC = NO CONNECT
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
Figure 8. Power Efficiency vs. Output Current

Figure 9. Output Resistance vs. Temperature

Figure 10. Charge Pump Frequency vs. Temperature
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.

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 $\mu$s) 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 $\mu$F or greater may be used.
OUTLINE DIMENSIONS

Figure 13. 6-Lead Small Outline Transistor Package [SOT-23] (RJ-6)
Dimensions shown in millimeters

ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature Range</th>
<th>Package Description</th>
<th>Package Option</th>
<th>Marking Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADM8828ARTZ-REEL7</td>
<td>−40°C to +85°C</td>
<td>6-Lead Small Outline Transistor Package [SOT-23]</td>
<td>RJ-6</td>
<td>M58</td>
</tr>
<tr>
<td>ADM8829ARTZ-REEL</td>
<td>−40°C to +85°C</td>
<td>6-Lead Small Outline Transistor Package [SOT-23]</td>
<td>RJ-6</td>
<td>MN0</td>
</tr>
<tr>
<td>ADM8829ARTZ-REEL7</td>
<td>−40°C to +85°C</td>
<td>6-Lead Small Outline Transistor Package [SOT-23]</td>
<td>RJ-6</td>
<td></td>
</tr>
</tbody>
</table>

1 Z = RoHS Compliant Part.
REVISION HISTORY

Updated Outline Dimensions ......................................................... 6
Changes to Ordering Guide ............................................................ 6

11/2006—Rev. 0 to Rev. A