AAT3110/AAT3111 On/Off Enable Control

General Description

The AAT3110 and AAT3111 switched capacitor voltage converters are designed to deliver a regulated 3.3V, 3.6V, or 5V output from an input supply ranging from 1.8V to 5V (respective to AAT3110/AAT3111 device option). No external inductor is required for operation. The AAT3110/AAT3111 can deliver a regulated voltage output for application loads up to 100mA. The device features very low quiescent current and high efficiency over a wide operating load range. Operating in a voltage-doubling mode, the AAT3110/AAT3111 uses pulse-skipping techniques to provide a regulated output from varying input supply voltages. The AAT3110 and AAT3111 contain thermal management circuits to protect the device under continuous output short-circuit conditions.

These attributes make the AAT3110 and AAT3111 a good choice for microprocessor back-up supply applications in battery-operated portable products, such as digital cameras and personal data assistants (PDAs). Such applications are often operated from lithium-ion/polymer batteries or, more commonly, two "AA" cell alkaline batteries.

Typical applications use enable/shutdown control signals which are independent of the device input power supply (see Figure 1). However, many circuit design applications require the device on/off shutdown (SHDN) pin to be connected directly to the IN pin to enable the charge pump.

![Figure 1: Typical AAT3110/3111 Application With Independent Shutdown Control.](image)

Application Problem

Applications utilizing the AAT3110 or AAT3111 in a battery back-up supply capacity can experience difficulties with disabling the device under certain conditions when the shutdown pin is connected directly to the IN pin (see Figure 2.) When the input power supply is removed and a large bulk capacitance exists on the output, the device may not shut down and can drain current from the output bulk capacitor. This is due to the fact that the shutdown pin must be pulled below a turn-off threshold \( V_{IL(VIN)} \). This can cause problems if an output bulk capacitor is being used for microprocessor memory keep-alive functions, as the output supply could be prematurely depleted.

For any given application, the shutdown turn-on and turn-off thresholds will vary depending upon the device output voltage and input supply voltage level. The most significant threshold to consider is the shutdown threshold, \( V_{IL} \). \( V_L \) for any given set of conditions may be determined by Equation 1:

\[
\text{Eq. 1: } V_{SHDN} \leq V_L(V_{IN}), \text{ when } V_{IN} = V_{OUT}/2
\]
Application Solution

The effect of a floating shutdown pin when it is tied to \( V_{IN} \) can be easily remedied by the addition of a few simple external components (refer to the circuit in Figure 3). The shutdown pin is automatically pulled below its \( V_L \) threshold whenever the input supply is removed, regardless of output load conditions.

One should first determine the operating \( V_{IL} \) level for the given set of conditions in an application. Determine the minimum operating input voltage and \( V_{DIL} \) for the given AAT3110/AAT3111 option.

Apply these terms to find the operating \( V_{IL} \) level using Equation 1. Once the operating \( V_{IL} \) has been determined, the required component values for \( R1, R2, D1, \) and \( D2 \) can be selected. In some cases \( D2, \) may not be necessary; conversely, additional diodes may be added if needed.

\[
V_{SHDN} = (V_{BAT} - V_{SHDIST}) \times k
\]

where \( k = \) Resistor voltage divider constant, \( R1 = 82k \) and \( R2 = 82k. \)

Figure 2: AAT3110/3111 Application With Shutdown Control Tied to Input Supply.

Figure 3: AAT3111 With Shutdown Control Circuit.
For the circuit shown in Figure 3, the following equations can be helpful:

Eq. 2: \( V_{\text{SHDN}} = (V_{\text{BAT}} - V_{\text{DROP(TOTAL)}}) \times k \)

Eq. 3: \( k = \frac{R_2}{(R_1 + R_2)} \)

Eq. 4: \( V_{\text{DROP(TOTAL)}} = V_{\text{DROP(D1)}} + V_{\text{DROP(D1)}} + V_{\text{DROP(D1)}} \)