LDOs and Load-Switches Implementation in 5V input applications on AmP8DB6 (Platform-B)

Application Note 210202

Description

Careful design considerations must be used when selecting and designing linear power components (LDOs and Load-Switches) for 5V VIN operation with the AnDAPT On-Demand PMICs. While PVIN (power FET drain) voltage range is explicitly specified in the datasheets of these power components, the chip bias voltage VIN must respect specific conditions to obtain the desired operation.

For example:

- For C710/C711 LDO Power Component, VIN must be 3.0V higher than the desired output voltage.
- For C750/C751 Load Switch Power Component, VIN must be 4.0V higher than the desired output voltage.

An example WebAmp project showing an instantiation of a C710 and a C750 is shown below.

When sufficient VIN headroom cannot be provided and in order to ensure that these conditions are met in 5V input applications this app note also describes circuit design solutions which employ a small number of external components which can be used to boost VIN to a suitably high voltage using charge-pump techniques when only 5V is available.

This app-note outlines two solutions to using a charge-pump to boost VIN from an external 5V (+/- 5%) thus allowing operation from 4.75V to 5.25V.

1. Solution 1 uses an internal clock via a GPIO to drive suitable external capacitor within a charge pump circuit.
2. Solution 2 uses the switching node (LX node) of a switching converter (if there is already one in the customers power tree) as the “clock” input to an external charge pump arrangement.

Solution 2 will be preferred when the design has an existing switching converter in the overall power tree and/or when an additional GPIO is not available. Otherwise Solution 1 may be preferred. Please contact AnDAPT for further application support and example schematics.

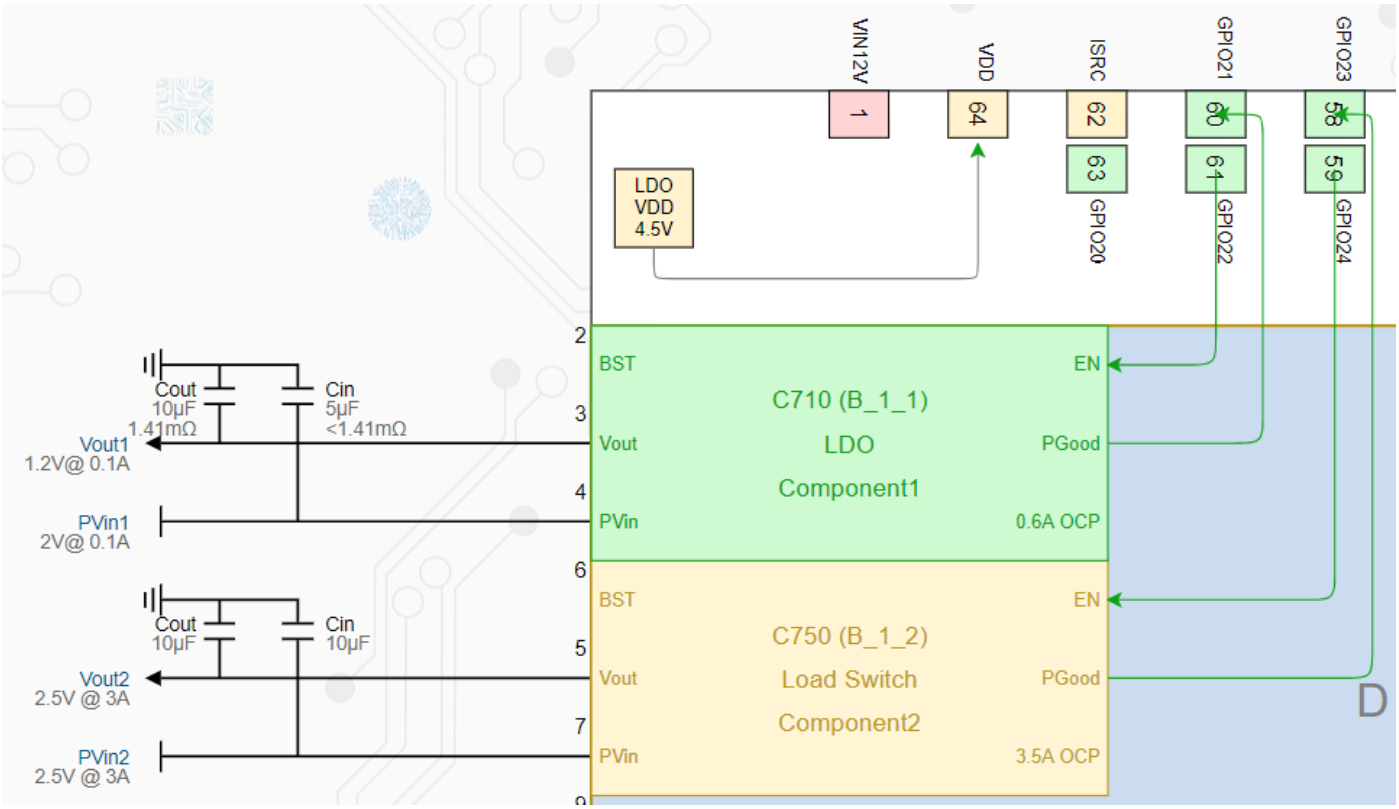


Figure 1. LDO and LDSW example WebAmP Design View showing VIN = 12V, PVIN1 = 2V and PVIN2 = 2.5V

Charge-Pump Solution 1

This solution employs a clock source (C431), which must be instantiated in the design, to provide a clock input for an external charge-pump which uses 3 external Schottky diodes as well as 2 1uF-10uF caps. In addition, the external 5V supply is used to overdrive the 4.5V. This is illustrated below in Figures 2 and 3 where we show two variations of this solution, Solution 1a where the GPIO voltage is fixed at for example 3.3V as determined by the appropriate VCCIO pin and Solution 1b where we also overdrive the VCCIO pin with the external 5V supply. Note that D3 is used to ensure a larger voltage on VIN during startup thereby ensuring VIN does not fall below the VIN UVLO level (approx. 4.0V). Solution 1b will provide for a higher VIN than Solution 1a if the application allows for GPIO levels of 5V.

In both cases the charge-pump output voltage (VIN) is given by Vext + VCCIO – (2 * Vf) where Vf is the forward voltage of the Schottky diodes.

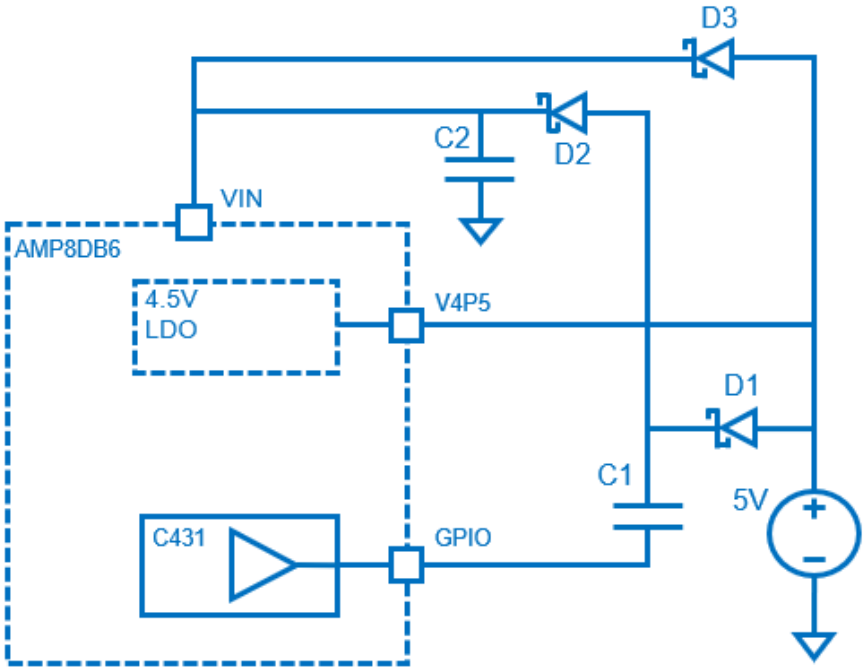


Figure 2. Charge-Pump Solution 1a using C431 as clock source for CP

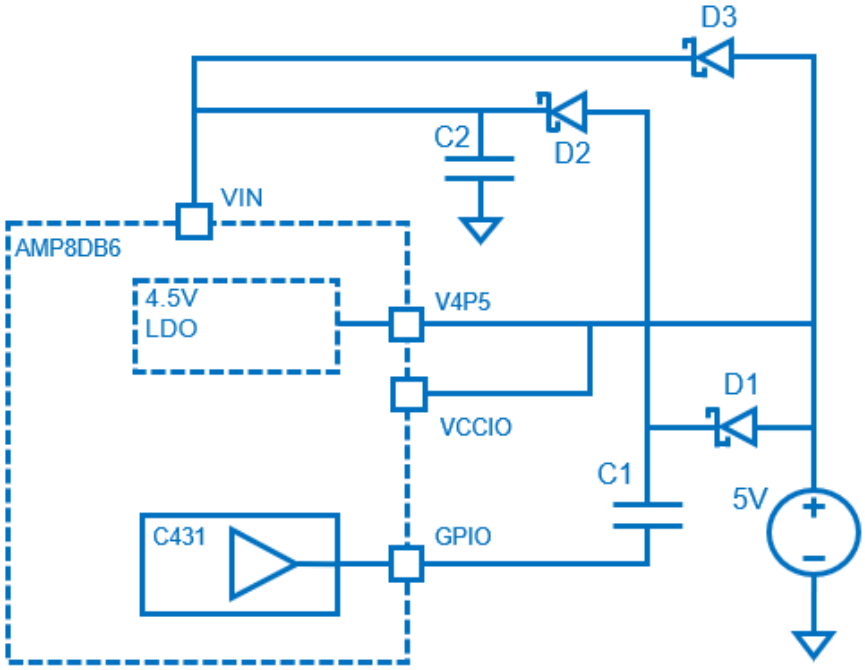
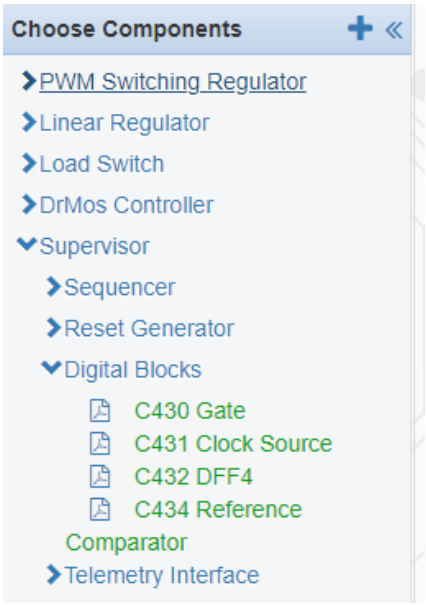
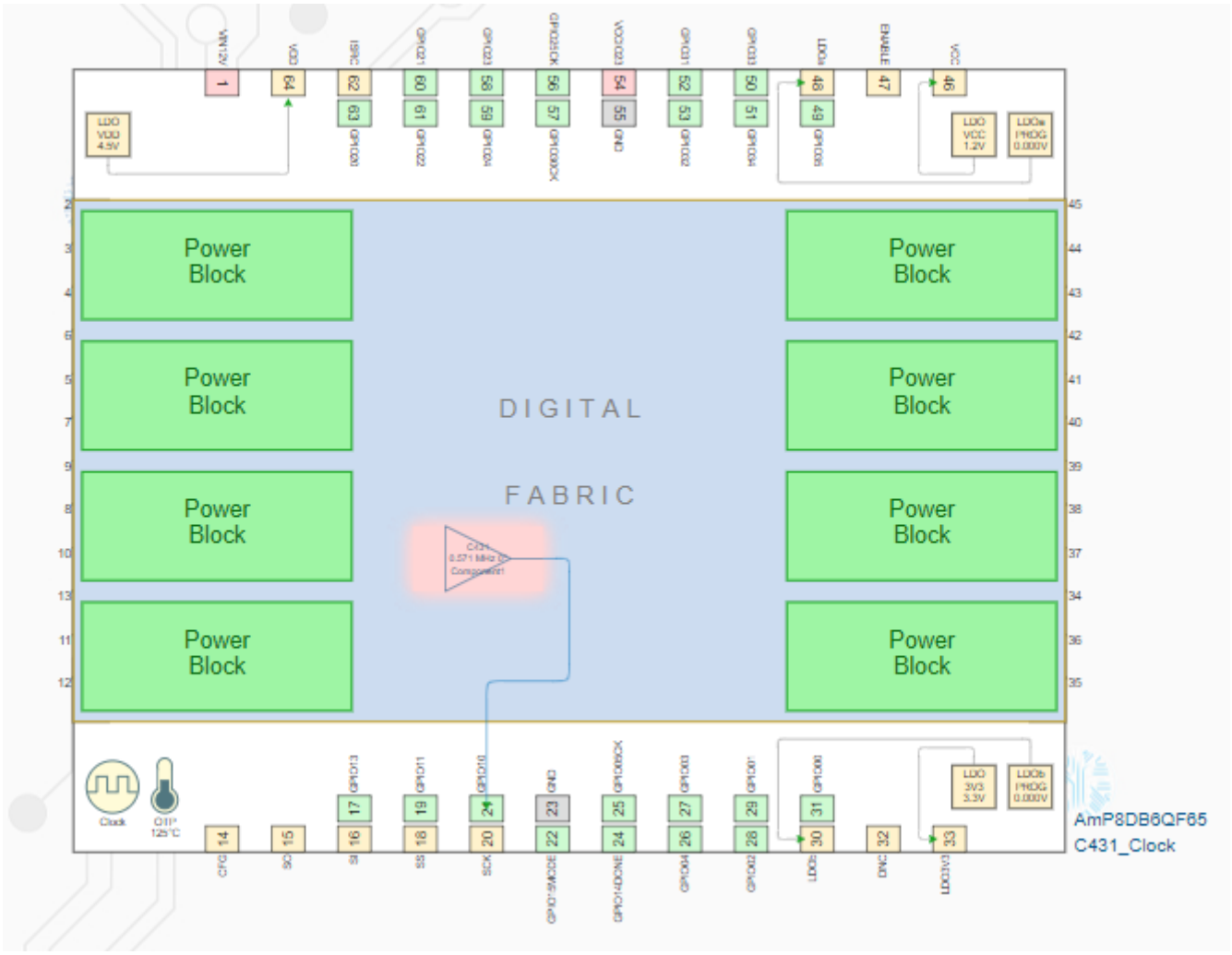


Figure 3. Charge-Pump Solution 1b with VCCIO also driven by external 5V

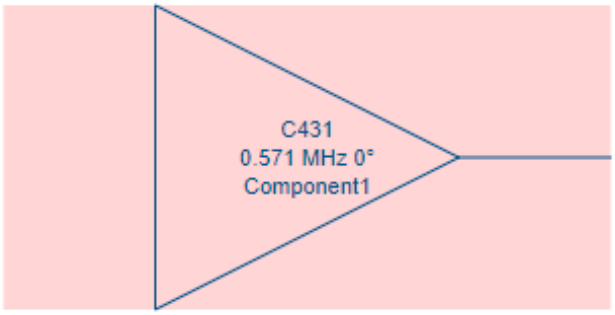
The C431 component is available under the “Digital Blocks” in the component selection menu:

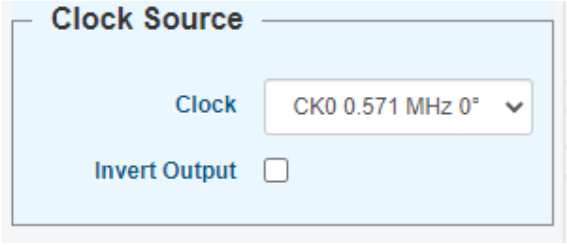


The instantiation of a C431 clock source component in WebAmp is illustrated below. The output of the C431 component should be connected to the GPIO which is to be used as the clock for the charge-pump

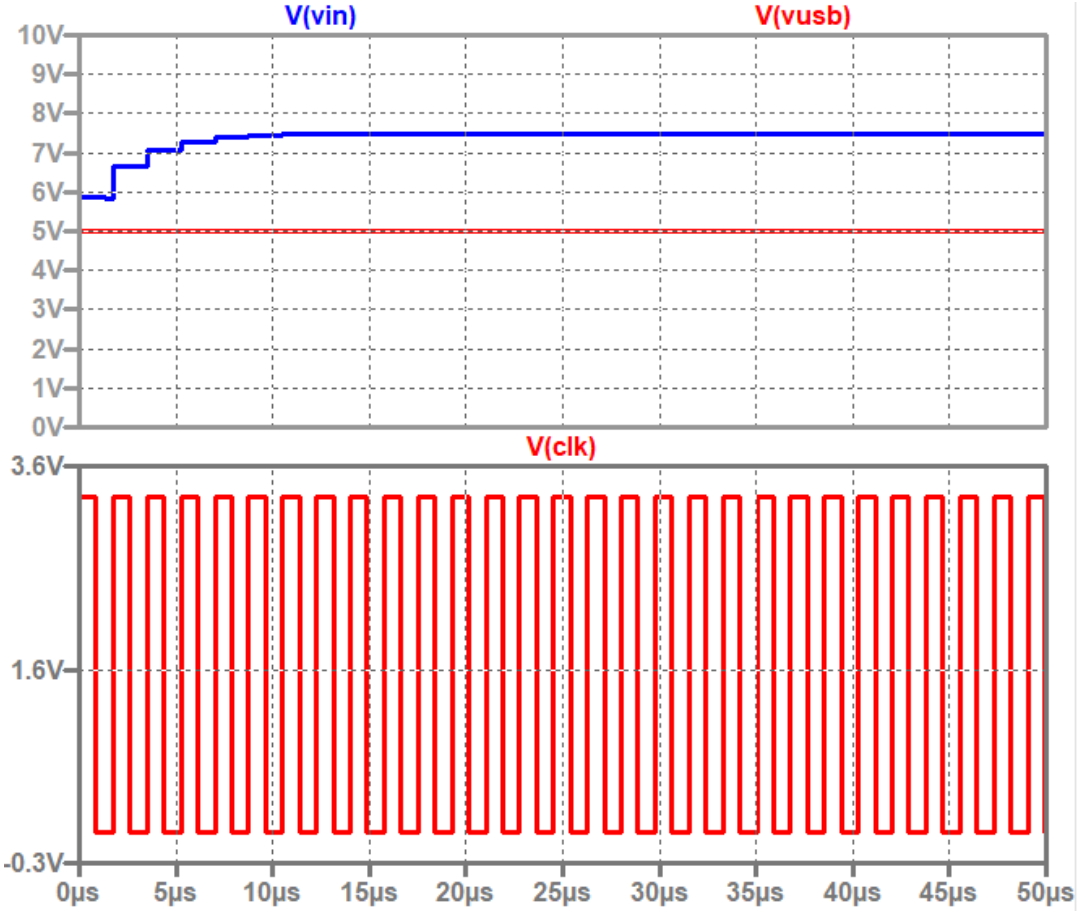


The default frequency of the C431 is 571KHz as can be seen by double clicking on the C431 symbol in WebAmp





When operating correctly typical startup waveforms for charge-pump Solution 1 a shown below:



Charge-Pump Solution 2

This solution uses the switching node of an already existing switching converter in the design to provide a clock input for an external charge-pump which requires 2 Schottky diodes as well as 2 1uF-10uF caps. As with Solution 1 one additional Schottky diode is required to ensure VIN is kept above the UVLO level during startup. This is illustrated below in Figure 4.

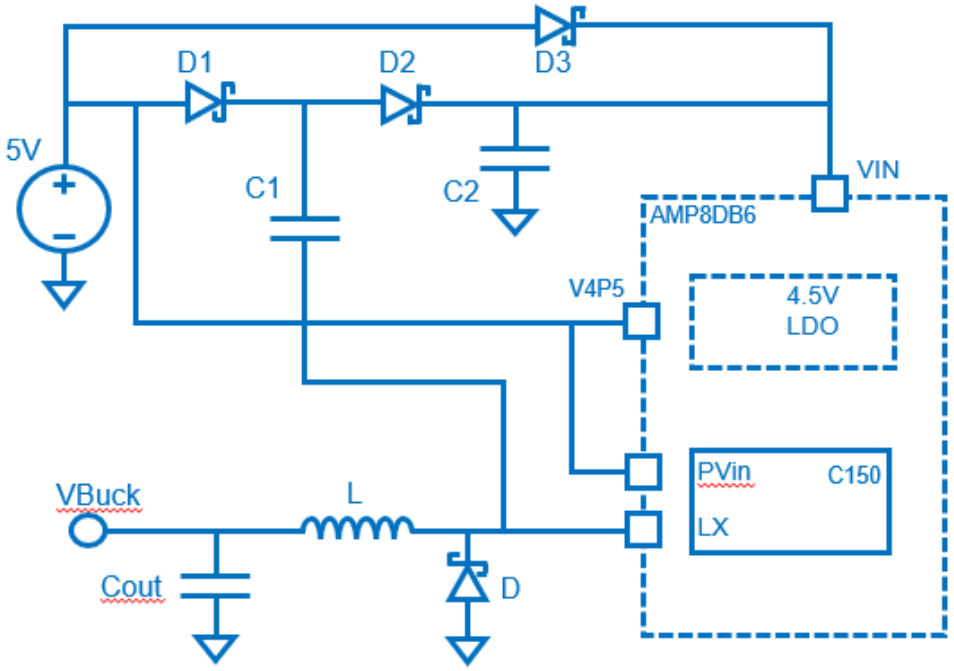
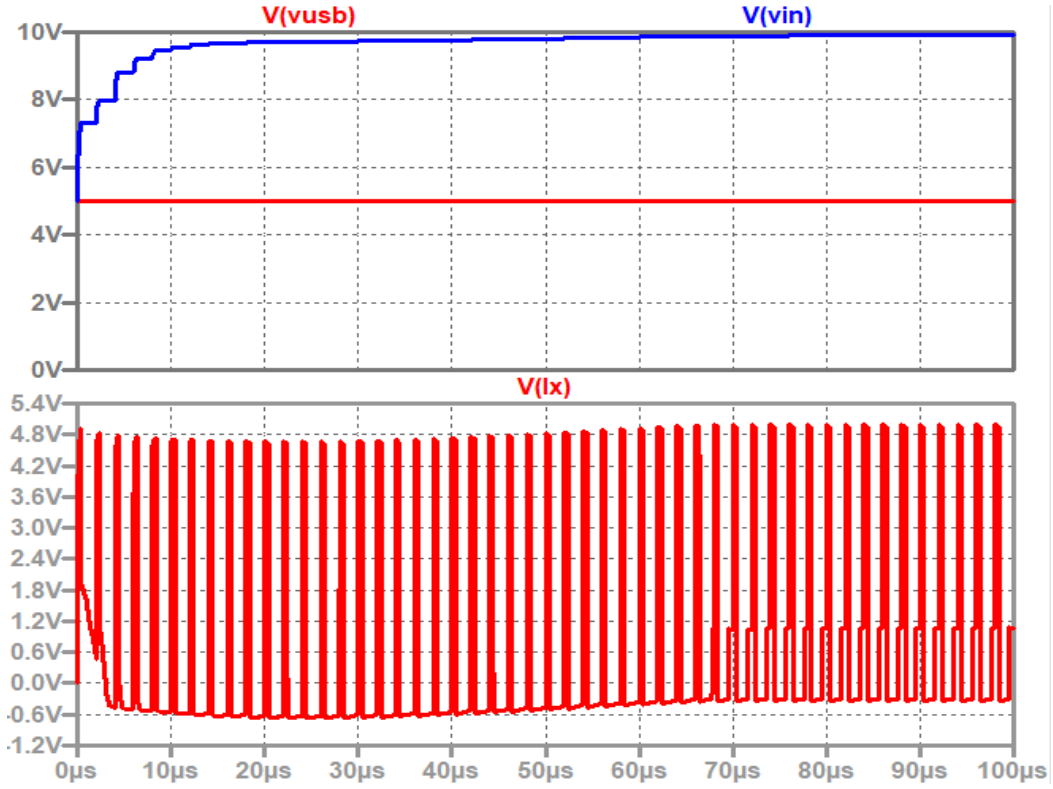


Figure 4. Charge-Pump Solution 2 using switching converter LX node as clock source for CP

Typical startup waveforms for charge-pump Solution 2 are shown below:



Component selection and switching frequency

Recommended component values and switching frequency as as follows:

Component	Value	Comments
C1	1uF – 10uF	
C2	10uF – 100uF	
D1, D2, D3	Vf ~ 0.4V	Use low Vf Schottky
C431 Clock Frequency	571Khz	

Revision History

Date	Revision
02/02/2021	Initial release

AnDAPT

On-Demand Power Management

www.AnDAPT.com

Trademarks