Selectable High Voltage Generation with GreenPAK

Author: Chuck Husted
Date: February 5, 2014

Introduction

Many circuits require higher voltages than the typical operating voltages of digital IC's. To create a design that can select a specific voltage digitally can be cumbersome. The GreenPAK product family, however, is ideally suited for supporting this type of design work. When used in conjunction with a programmable reference like the TL431, the GreenPAK can simplify the design.

TL431 Background

The TL431 is a three terminal programmable voltage reference. It is capable of output voltages up to 36 VDC.

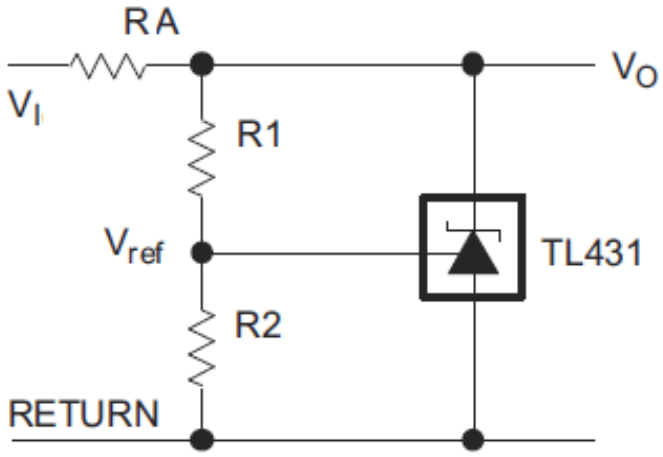

Figure 1. TL431 configured as a shunt regulator

To calculate Vo based on the V_{REF} internal use Equation 1.

$$V_O = V_{REF} * (1 + \frac{R1}{R2})$$

Equation 1. Relationship between Vo and V_{REF}

GreenPAK Circuit Design

In order to create a selectable high voltage generator, we will need to have a method of selecting different output voltages from the TL431. The easiest way would be to use resistors in parallel with R2. When each resistor is in the circuit it will change the total resistance to ground, and ultimately the Vo.

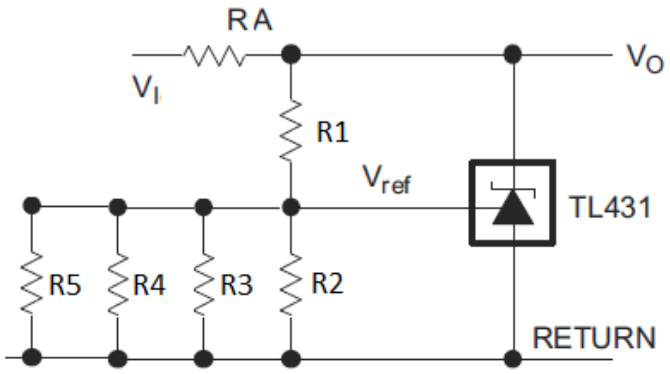

Figure 2. Generating four voltages with the TL431

Assuming that we would like to see 5V, 9V, 12V and 20V as outputs from this circuit, we need to determine what the R2, R3, R4 and R5 values should be. Let us use R2 to generate 5V, R3 to generate 9V, R4 to generate 12V, and R5 to generate 20V. We will find that R1 = 100 kΩ, R2 = 99.6 kΩ, R3 = 62.4 kΩ, R4 = 83.2 kΩ, and R5 = 31.2 kΩ.

To control whether each resistor is in the circuit or not, we will use four GPIO's from a GreenPAK2. We will configure each GPIO as an open drain that will connect between its resistor and ground. See Figure 3 for the implementation and connections.

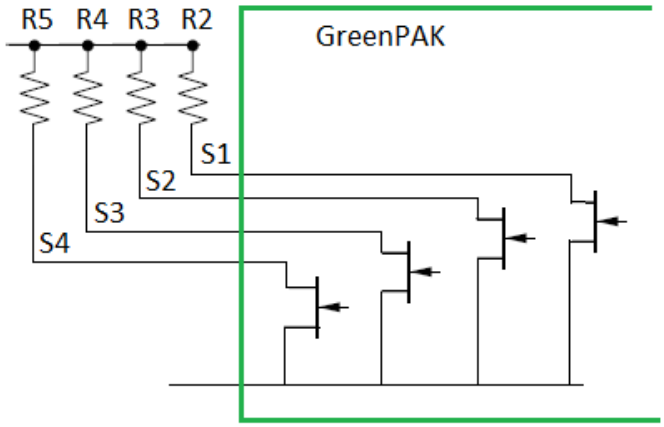

Figure 3. R2 – R5 connections to ground through GreenPAK GPIO's configured as open drain

The last circuit configuration is how the resistors are selected. We will use two inputs (IN1 and IN0) to configure the four outputs. This table shows the details on how the inputs determine the output settings.

IN1	IN0	GND	Hi-Z	Vo
Low	Low	S1	S2, S3, S4	5V
Low	High	S1, S2	S3, S4	9V
High	Low	S1, S2, S3	S4	12V
High	High	S1, S2, S3, S4	None	20V

The last portion of the circuit to complete is the logic that converts the two inputs into the four output states. A simple DE-MUX design using four look up tables will suffice. The final GreenPAK2 design is available for download to review and is shown in Figure4.

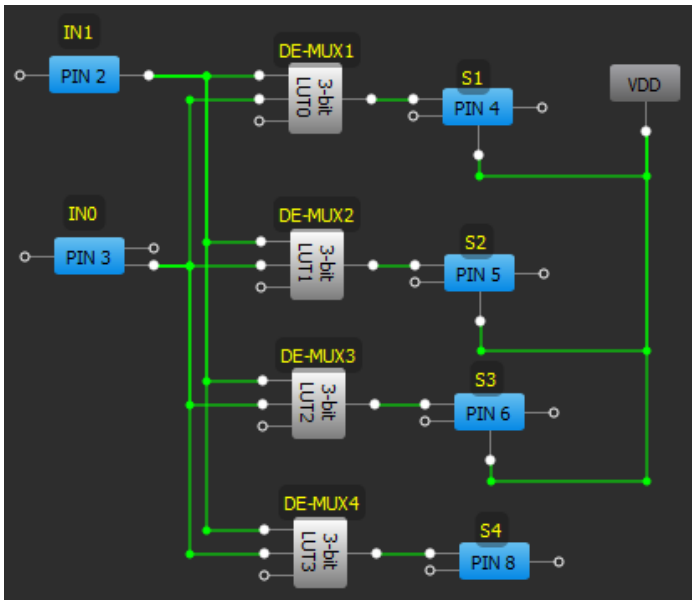

Figure 4. Final GreenPAK design

Related Files

Programming code for **GreenPAK Designer**.

About the Author

Name: Chuck Husted

Background: Chuck earned his BSEE from Northern Illinois University with specialization in RF. He has worked for over 20 years in the frequency control field designing many types of quartz crystal based oscillators (XO's, VCXO's, TCXO's, and OCXO's) using discrete analog and RF circuitry. Chuck has also managed engineering teams around the globe. He recently earned his MBA.

Contact: **chusted@silego.com**

Document History

Document Title: Selectable High Voltage Generation with GreenPAK

Document Number: AN-1020

Revision	Orig. of Change	Submission Date	Description of Change
A	Chuck Husted	02/05/2014	New application note

Worldwide Sales and Design Support

Silego Technology maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at **Silego Locations**.

About Silego Technology

Silego Technology, Inc. is a fabless CMIC company headquartered in Santa Clara, California, with operations in Taiwan, and additional design/technology centers in China, Korea and Ukraine.

Silego Technology Inc.
1715 Wyatt Drive
Santa Clara, CA 95054

Phone : 408-327-8800
Fax : 408-988-3800
Website : www.silego.com