# GreenPAK Macro Circuit Design: SPI Code Detector

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## Introduction

The S2P block has two 16-bit registers (2 bytes) that are used for data transfer. An external clock signal comes from PIN5 and the nCSB (active LOW Enable Control Signal) comes from the Connection Matrix Out. For serial to parallel operation (S2P), the serial data input (MOSI) is sourced from PIN6.

The pipe delay cell is built from 12 D Flip-Flop logic cells, and provides three delay options. DFF cells are tied in series where the output (Q) of each delay cell goes to the next DFF cell. The sum of the number of DFF cells used will be the total propagation delay of the Pipe Delay logic cell.

## SPI Code Detector Circuit Design

The screen capture of S2P, DCMP and Pipe Delay can be seen on Figure 3. The S2P block is connected to PIN5, PIN6, which are configured as Digital in without Schmitt trigger and without any pull up/down resistor. Output of 2-bit LUT1 will be LOW when IN1 is HIGH and IN0 – LOW. Output of 3-bit LUT0 will be LOW when IN1 is HIGH, IN2 and IN0 – LOW All outputs are configured to be push-pull.

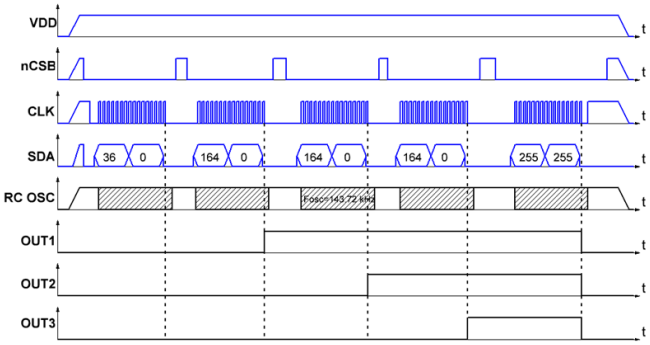


**Figure 1. SPI Code Detector timing diagram**

## SPI Code Detector Circuit Analysis

Figure 2 shows the operation of the design. If serial data is unequal to $164_{10}=10100100_2$ all outputs will be LOW. When serial data is equal to $164_{10}$ then output OUT1 will go HIGH. If next sample of serial data is equal to $164_{10}$ then outputs OUT1, OUT2 will go HIGH. If the following sample of serial data is equal to $164_{10}$ again then outputs OUT1, OUT2, OUT3 will be HIGH.

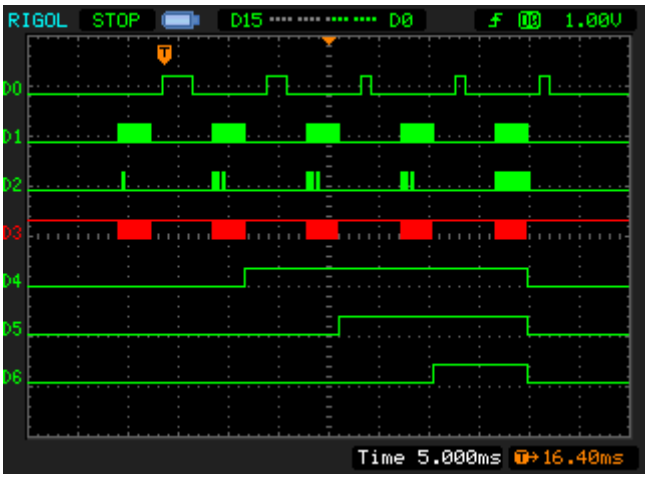


**Figure 2. SPI Code Detector output waveform. Top line is S2P nCSB input, 2nd line is S2P CLK input, 3rd line – S2P SDA input, 4th line – RC OSC output, 5th line – DCMP EQ output, 6th line – Pipe Delay OUT2 output, bottom line – Pipe Delay OUT3 output**

## Related Files

Programming code for **GreenPAK Designer**.

## Conclusion

The S2P block is a standard communication block used in many devices and systems. The ease of use and configurability of this block in GreenPAK2 devices makes it a perfect candidate to replace bigger and more expensive microcontrollers.

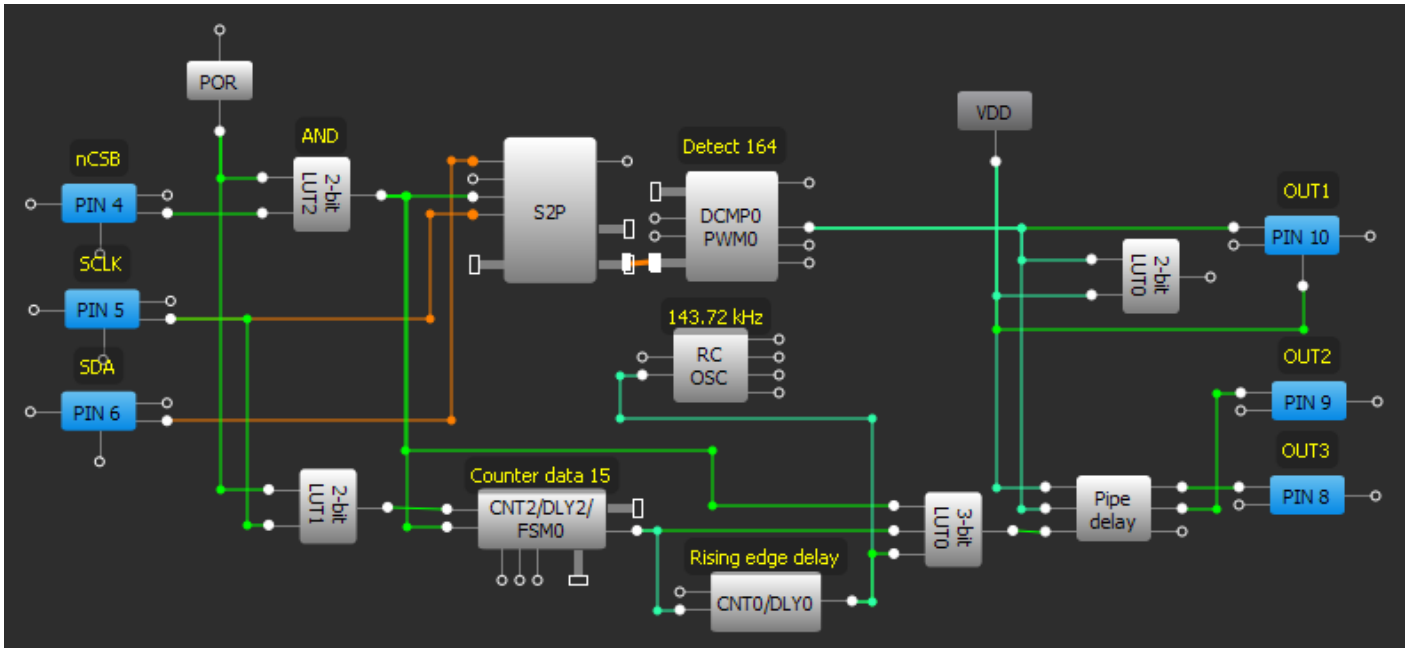


**Figure 3. SPI Code Detector block diagram**

## About the Author

Name: Bogdan Holod

Background: Bogdan Holod graduated from Lviv Polytechnic National University in 2011 and received a Master's Degree in Radio engineering devices, systems and complexes. Since 2012 he has been working as a design engineer and has got experience in designing low power analog systems, developing designing guidelines of digital and analog electronic circuits.

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## Document History

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| A | Bogdan Holod | 08/22/2013 | New application note |

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