Application Note

PWM Frequency Converter

AN-CM-271

Abstract

This application note describes how to shift frequency of PWM signal without loss of duty cycle.

This application note comes complete with design files which can be found in the References section.

Contents

Figures

1 Terms and Definitions

PWM	Pulse width modulation
SPI	Serial peripheral interface
FSM	Finite state machine
CNT	Counter
OSC	Oscillator
DCMP	Digital comparator

2 References

For related documents and software, please visit:

GreenPAK™ Programmable Mixed-Signal Products | Renesas

Download our free GreenPAK™ Designer software [1] to open the .gp files [2] and view the proposed circuit design. Use the GreenPAK development tools [3] to freeze the design into your own customized IC in a matter of minutes. Find out more in complete library of application notes [4] featuring design examples as well as explanations of features and blocks within the GreenPAK IC.

[1] GreenPAK Designer Software, Software Download and User Guide

[2] AN-CM-271 PWM Frequency Converter.gp, GreenPAK Design File

[3] GreenPAK Development Tools, GreenPAK Development Tools Webpage

[4] GreenPAK Application Notes, GreenPAK Application Notes Webpage

Author: Ivan Vaskiv

3 Introduction

Sometimes there is a need to change a frequency with retain a duty cycle. The following design allows changing frequency and retaining the duty cycle.

4 How it works?

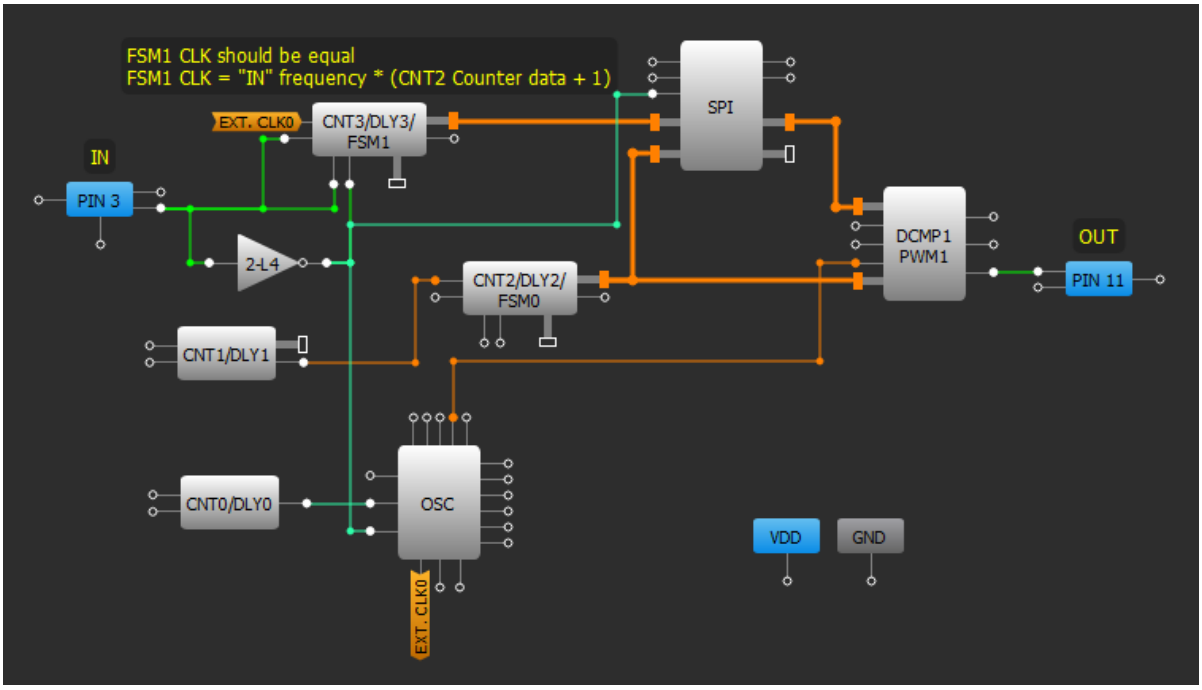

Figure 1: PWM Frequency Converter

This design is designated to change the input frequency without loss of the duty cycle value. It only allows to do that for one constant frequency.

Let's see how it works. When PIN#3 goes HIGH, FSM1 is reset by the rising edge and starts to count UP, thus measuring the pulse width. Then, when PIN#3 goes LOW FSM1 stops and falling edge at PIN#3 through invertor 2-L4 writes FSM1 counter value into SPI buffer. This operation is repeated each period.

At the same time, CNT2 just counts input frequency from CNT1. The counter value of CNT2 all time is compared with SPI buffer's value by the DCMP1. The frequency at "OUT" is equal to output frequency of CNT2. To change the "OUT" frequency input frequency of CNT2 should be changed. Namely, CNT1 counter data can be changed, oscillator divider can be changed, type of OSC can be changed, also input frequency can be taken directly from OSC or external oscillator.

The input frequency of FSM1 (FSM1 CLK) should be selected using following formula:

FSM1 CLK = "IN" frequency × (CNT2 Counter data + 1)

"IN" frequency – frequency at PIN#3

If CNT0 counter data is 255, the formula can be written as:

FSM1 CLK = 256 × "IN" frequency

To change the FSM1 CLK, CNT0 counter data can be changed, oscillator divider can be changed, type of OSC can be changed, also CNT2 counter data can be changed.

Below are shown several scope shots of the design's functionality.

Channel 1 (yellow/top line) – PIN#3 (IN)

Channel 2 (light blue/2nd line) – PIN#11 (OUT)

Figure 2: Shifting Input Frequency from 100 Hz to 300 Hz

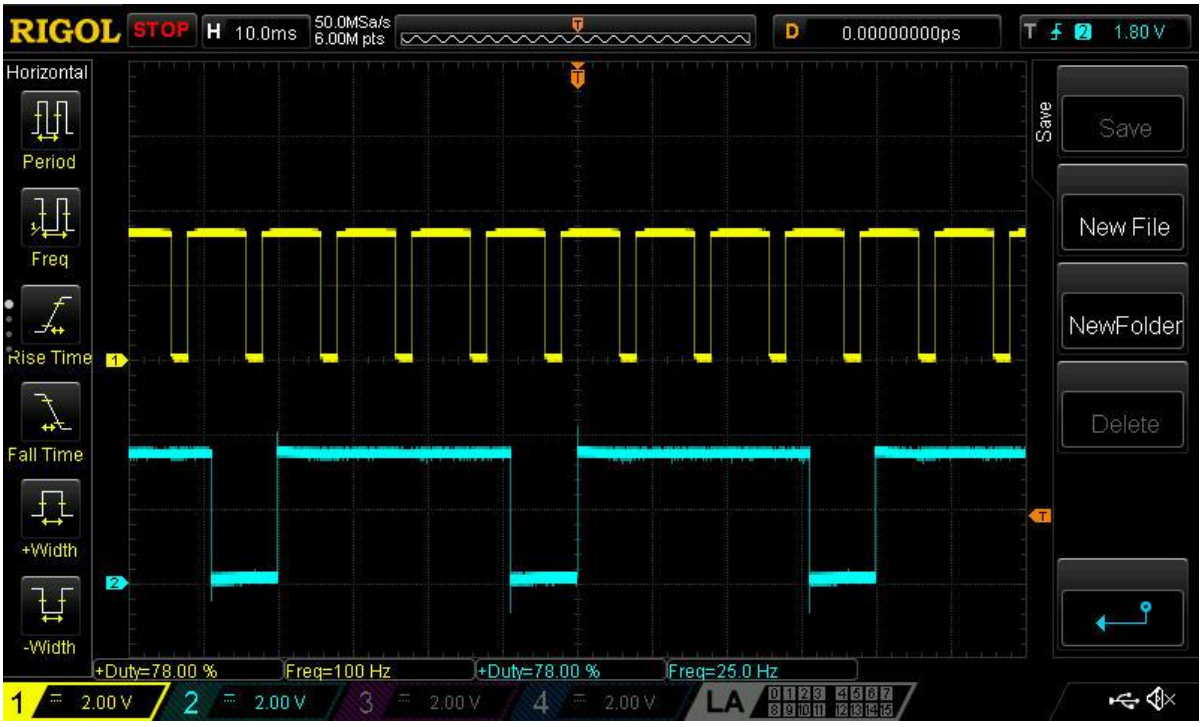

Figure 3: Shifting Input Frequency from 100 Hz to 25 Hz

Figure 4: Shifting Input Frequency from 100 Hz to 7.81 kHz

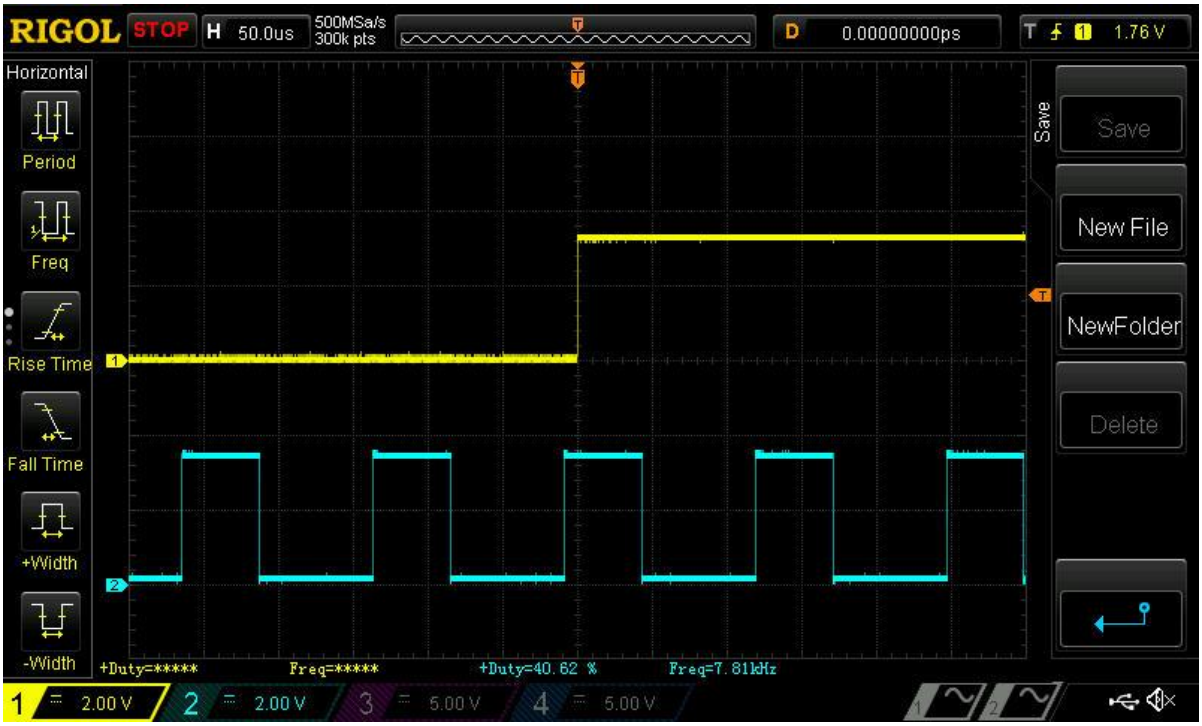

Figure 5: Zoomed Figure 4.

Figure 6: Shifting Input Frequency from 1 kHz to 4 kHz

5 Conclusions

This design can be used in many projects where there is a need to change a constant input frequency without loss of the duty cycle, for example LED backlight, motor controller, voltage regulator etc.

Revision History

Revision	Date	Description
1.0	21-Jan-2019	Initial Version

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