Digitally Controlled Sine-Wave Generator Using the MAX32630FTHR and MAX7400

MAXREFDES1264

Introduction

TThe MAXREFDES1264 is a reference design for the MAX32630FTHR and MAX7404. It produces an accurate variable frequency sine wave for use as a general-purpose reference signal. The MAX7404 is an eighth-order elliptic switched-capacitor lowpass filter. The MAX32630FTHR is an ARM core-based low-power microcontroller board used to provide the clock and input signal to the MAX7400.

Designed–Built–Tested

This document describes the hardware in Figure 1. It is a detailed, systematic technical guide to use a small, low-cost, portable sine-wave generator. The design was built and tested. The details follow later in this document.

Table 1. Design Specifications

PARAMETER	SYMBOL	MIN	MAX
Input Frequency	V_{IN}	0Hz	5kHz
Clock Frequency	CLK_IN	0Hz	500kHz

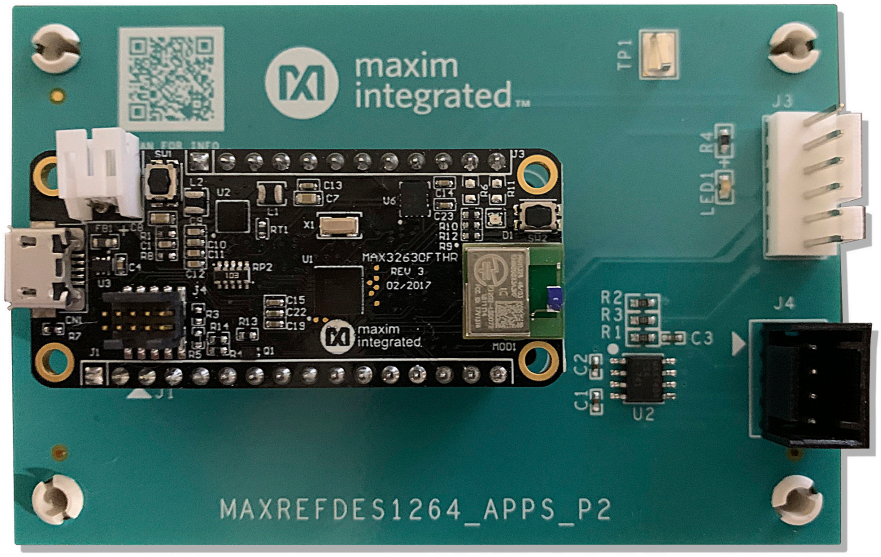

Figure 1. MAXREFDES1264 hardware.

Recommended Equipment

- MAXREFDES1264
- A laptop or PC

Design Procedure

A sine wave with an arbitrary frequency is needed as a reference signal during various designs and testing. A simple sine wave is generated by passing a square wave through a lowpass filter. The MAX7404 is the lowpass filter used in this design. It is an eighth-order elliptic switch-capacitor filter that converts the input square wave to a sine wave (Figure 2).

The microcontroller acts as a square-wave generator feeding the filter with both clock and input signals. The filter's cut-off frequency is 1/100 of the clock frequency. The user can modify the frequencies through a serial monitor program from the PC. The algorithm works as follows:

The microcontroller clocks the filter with a 100kHz square wave. The input frequency of the filter is 1kHz. The eighth-order elliptic filter's sharp roll off sharply reduces the harmonic amplitudes in a 1kHz square-wave input, thereby producing a near-perfect 1kHz sine wave at its output. A digitally adjustable sine-wave source can be created by adjusting the clock and input frequencies, and while maintaining a ratio of 100:1 between them (using the divider-chain logic or a processor). Figures 3, 4, and 5 show the clock, input, and output signals, respectively.

Firmware Design

The firmware is developed using an online MBED compiler. The input frequencies can be varied using a serial application like the tera term using the Universal Serial Bus-Universal Asynchronous Receiver/Transmitter (USB-UART) protocol. The microcontroller feeds the filter with the square waves. The firmware is tested. It can be downloaded from the design resources tab. The filter has a cut-off frequency of 10kHz, which needs a clock signal of 1MHz. The firmware is designed to support an input signal range from 0 to 5kHz due to the limitations of the MBED compiler to generate a 1MHz clock signal.

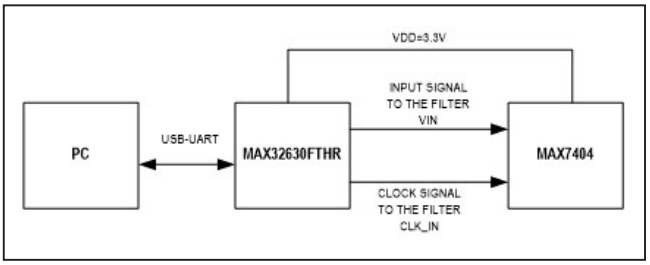

Figure 2. Block diagram

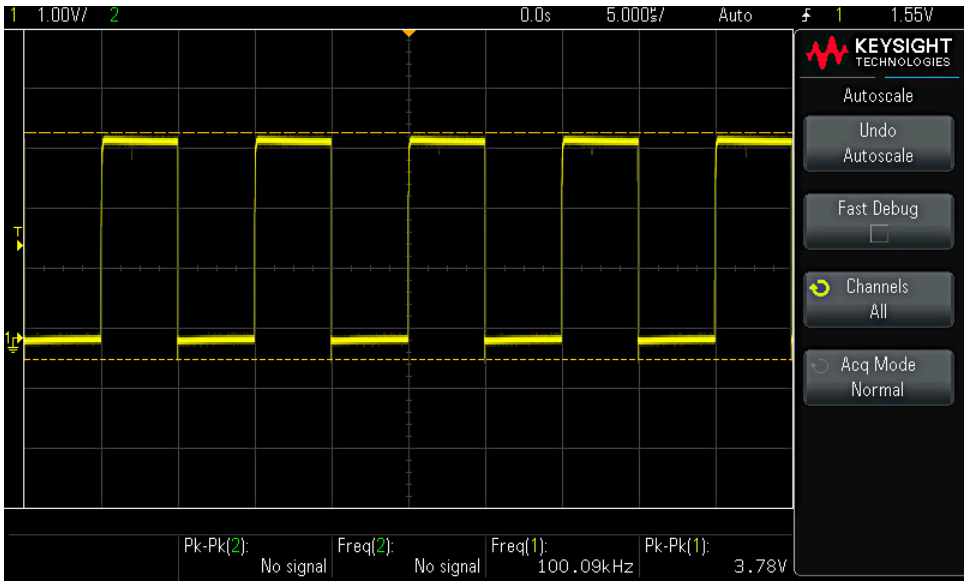

Figure 3. Clock signal to the filter.

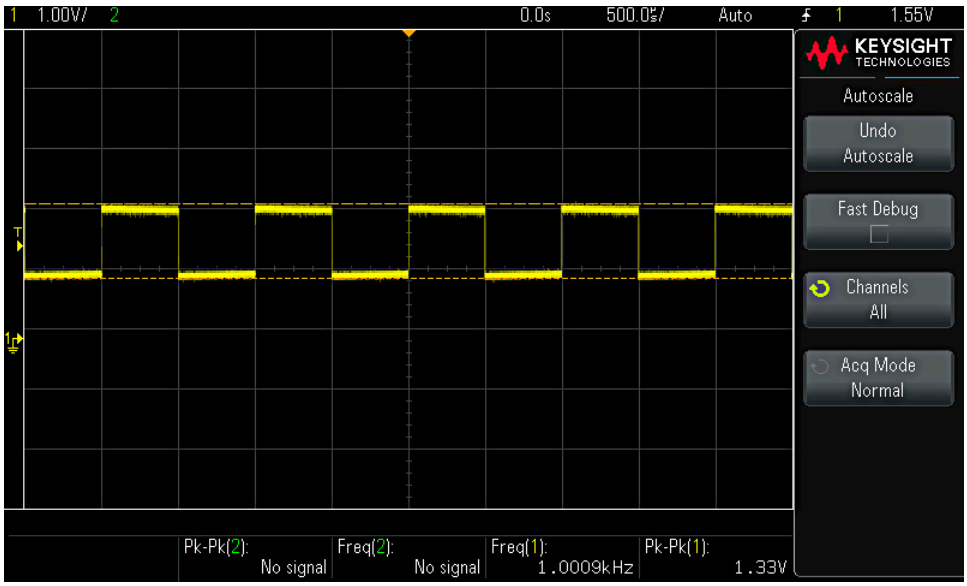

Figure 4. Input square wave to the filter.

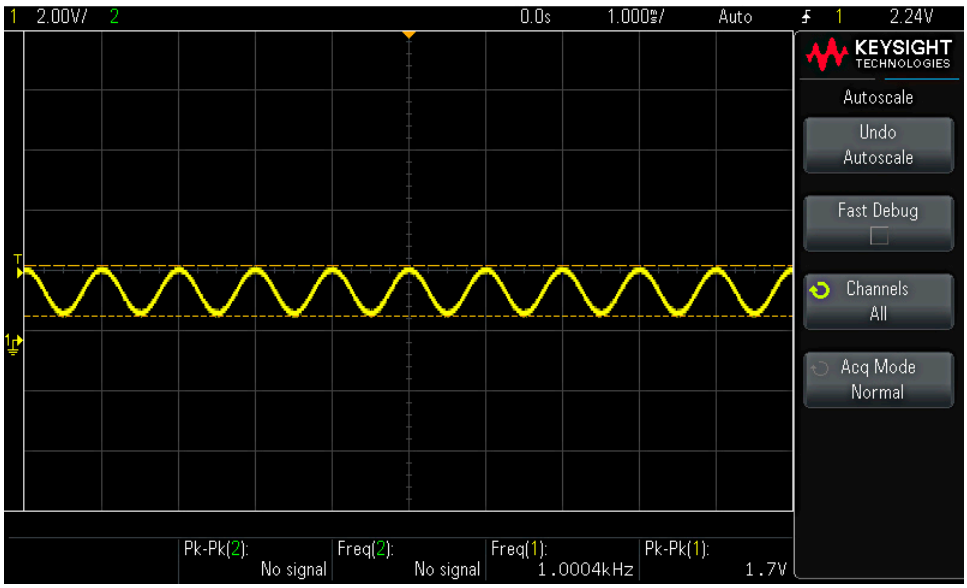

Figure 5. Output sine wave.

Design Resources

Download the complete set of **Design Resources** including schematics, bill of materials, PCB layout, and test files.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/21	Initial release	—