
FSK Generation Using the SX Microcontroller



Application Note 9

Stephen Holland

June 1999

1.0 Introduction

This document describes the use of a Scenix SX microcontroller to perform FSK (frequency-shift keying) demodulation. FSK is a form of modem communication techniques.

In the past, such telephony functions as FSK generation and detection, DTMF (dual-tone, multi-frequency) generation and detection, and Caller ID could not be implemented with an 8-bit embedded MCU because performance levels were not high enough to support them. As a result, either a custom MCU had to be designed or a 16- or 32-bit device be used. Now, the 8-bit Scenix Semiconductor SX Series MCUs with performance reaching 100 MIPS (million instructions per second) and a deterministic interrupt architecture, overcome this challenge by providing the ability to perform these functions in software.

Unlike other MCUs that add functions in the form of additional silicon, the SX Series uses its industry-leading performance to execute functions as software modules, or Virtual Peripheral™ modules. These modules are loaded into a high-speed (10 ns access time) on-chip flash/EEPROM program memory and executed as required. In addition, a set of on-chip hardware peripherals is available to perform operations that cannot readily be done in software, such as comparators, timers, and oscillators.

With frequency shift keying, the transmitting modem converts a bitstream (1's or 0's) into a varying frequency which can be easily transmitted over telephone lines. The receiving modem receives this modulated signal and transforms it back into a bitstream. In the Scenix solution, the receiving of FSK is done using a very simple zero-cross method. The simplicity of the algorithm results in a program size of only 67 words. In addition, the algorithm requires only 2 bytes of RAM and one I/O pin to receive an FSK modulated signal. The FSK specification described in this document uses 1300Hz to represent a '1' and 2100Hz to represent a '0'. The maximum data rate for this type of modulation is 1200 baud.

To minimize code space and required processing power, this FSK modulation technique uses an artificial sine wave generator to simulate the characteristics of a real sin wave, without the use of a large lookup table. The sin wave generator utilizes the properties of gravity to create a near-perfect sine wave at the desired frequency.

2.0 Hardware

Figure 2.1 shows the necessary hardware for FSK generation

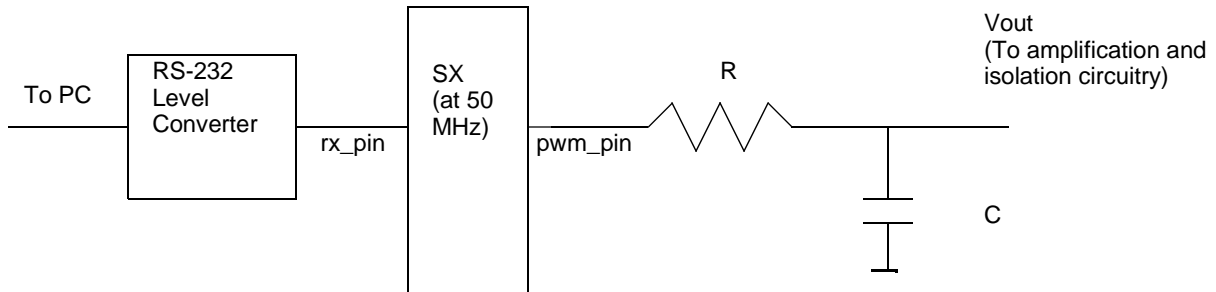


Figure 2-1. Hardware for FSK Generation

Depending on the maximum frequency you wish to obtain, you should adjust the component values for R and C to choose the resolution of the PWM. Ideally, you should calculate the maximum sine frequency output you will use and choose the cutoff to be at this frequency. For instance, for a maximum output frequency of 2.1kHz, calculate R and C:

First, choose a value for R.

R=1000 ohms

Now, calculate C:

$$C = 1/(2 * \pi * \text{Cutoff Frequency} * R)$$

Therefore:

$$C = 1/(2 * 3.14 * 2100\text{Hz} * 1000 \text{ ohms})$$

And

$$C = 0.076\mu\text{F}$$

The software is designed to run on the Scenix DTMF demo boards. To build and test the demo yourself, these are the pins to which your hardware should be connected:

PWM_pin	equ	ra.0	Pin used for PWM output
rx_pin	equ	ra.1	Pin used for RS-232 receive
tx_pin	equ	ra.2	Pin used for RS-232 transmit
led_pin	equ	rb.0	For visual indication of transmitted data

3.0 Software

The software consists of an interrupt service routine and a mainline routine. The two run independently, with the mainline routine loading the frequencies for the interrupt service routine to output, depending on the state of the RS-232 input pin.

This software has been tested using the Scenix FSK receive modem software, which has been tested with a production BELL202 modem and with Caller ID signals from the telephone company.

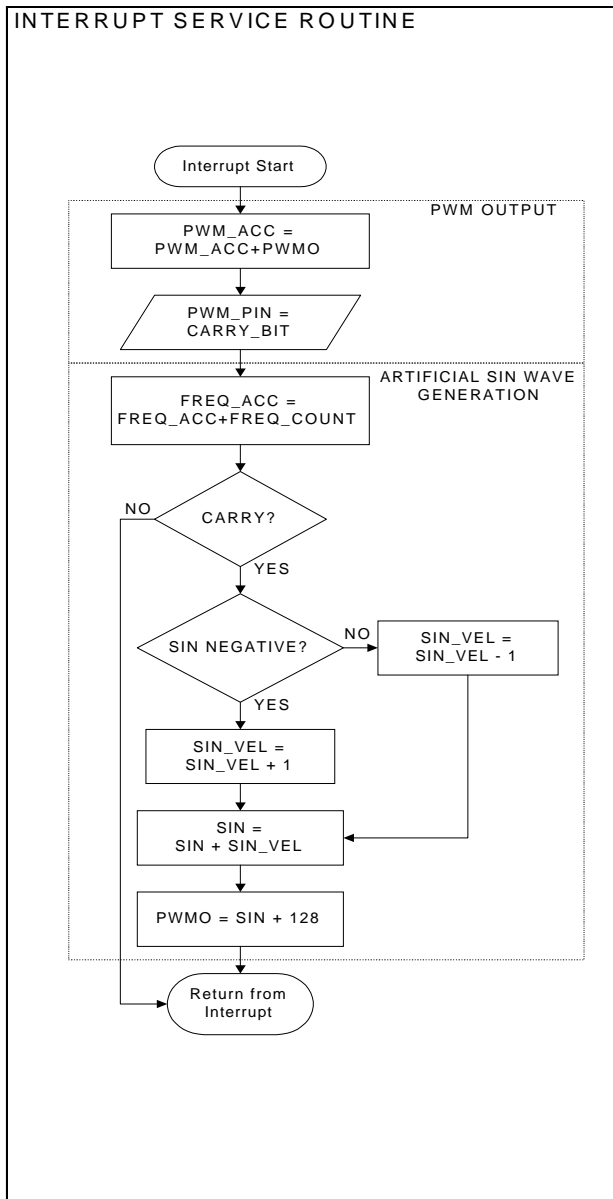


Figure 3-1. Interrupt Service Routine Flowchart

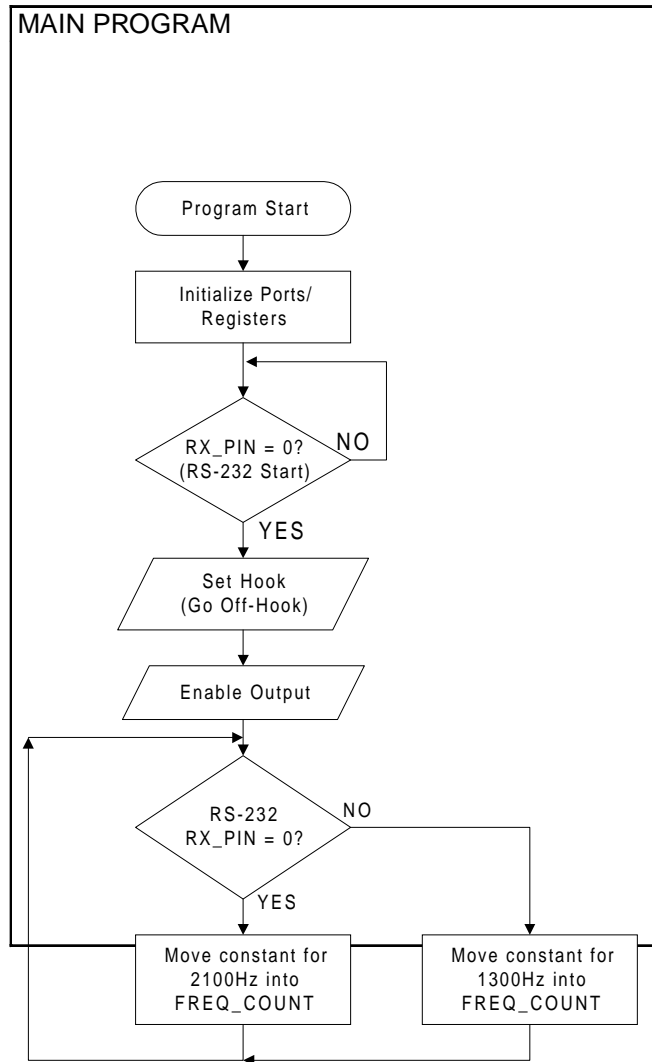


Figure 3-2. Main Program Flowchart

This is an extremely simple method to perform FSK modulation. To make the system more powerful, an RS-232 UART could be added so the incoming RS-232 data can be processed (Required to implement an AT-command set). To create a full modem solution, this software module must be combined with the FSK receive module and the DTMF transmit (Dialing) module.

For more information on frequency generation, FSK reception, or DTMF generation, consult the Scenix web site at www.scenix.com

Lit#: SXL-AN09-01