Consumer/Industrial - Dog Bark Eliminator (Bark 'n' Squeal)

AN2212

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Associated Project: Yes
Associated Part Family: CY8C25xxx, CY8C26xxx
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Software Version: PSoC Designer™ 4.1
Associated Application Notes: None

Application Note Abstract

The PSoC® is configured with three PGAs, a two-pole band pass filter, a comparator, and a counter, for use as a battery-operated dog bark detector and ultrasonic emitter. It uses a single mini-speaker for input and output.

Introduction

It's well known that many animals are particularly sensitive to high-frequency sounds that humans are unable to hear. Many commercial pest-repelling devices based on this principle are available, most of them operating in the range of 30 to 50 kHz. The aim of this project, however, is to design a slightly different ultrasonic sound generator that could be used to train dogs.

Just imagine the possibilities - make your pet think twice before barking again in the middle of the night. Dogs tend to respond best to frequencies between 15 and 25 kHz, and older canines are less susceptible to higher tones.

This PSoC project outputs a sweeping ultrasonic signal throughout the range of 15-19 kHz to ensure effectiveness upon detecting a bark from the dog wearing the device on its collar. It is a simple matter to make it sweep all the way up to 25 kHz, but the particular speaker used in this project had no frequency response above 19 kHz.

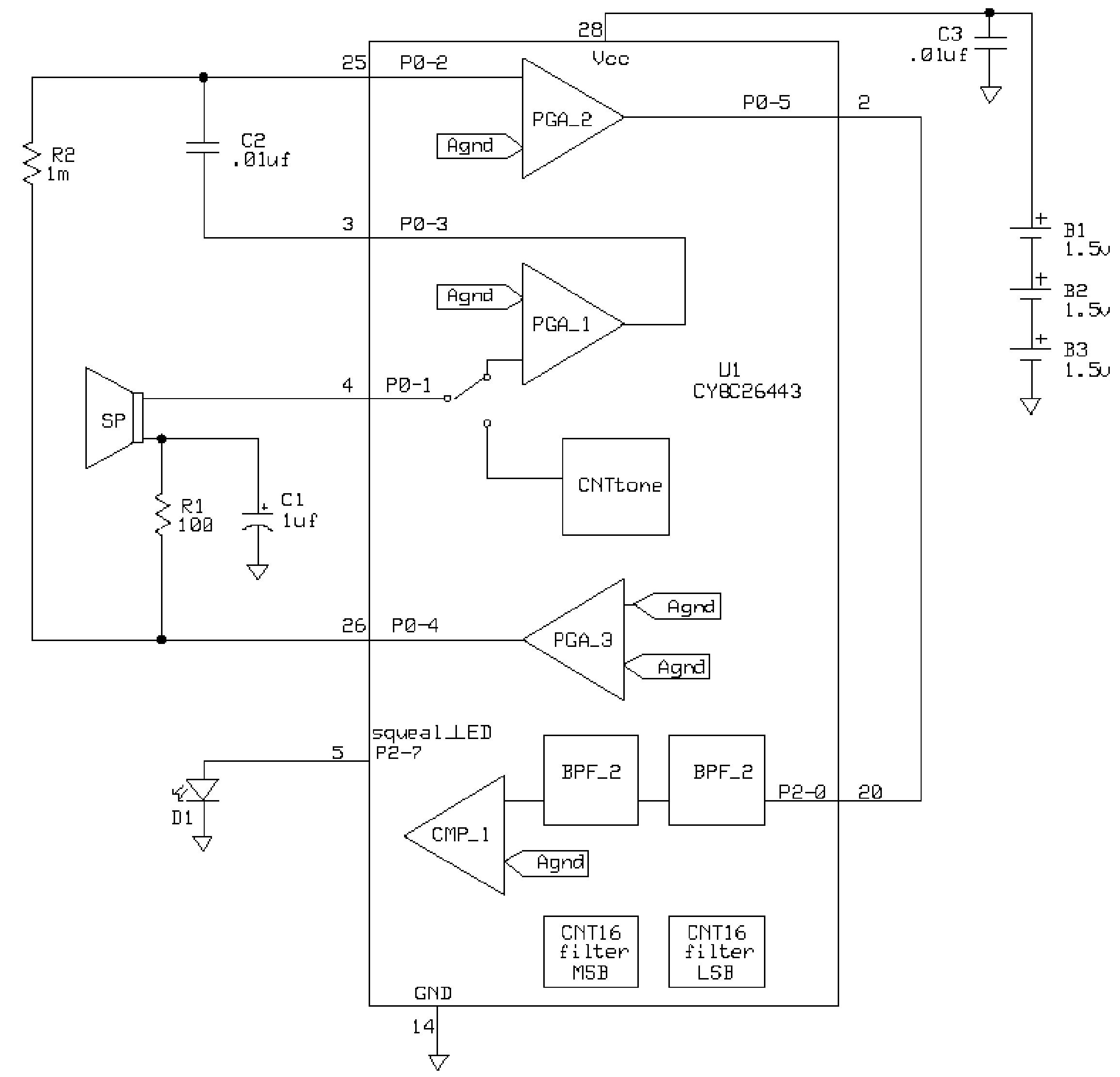
Software/PSoC Implementation

The PSoC implementation involves an interesting setup for the analog audio portion. Two stages of PGAs are used in series to apply plenty of gain to the microphone/speaker for adequate sensitivity. The output goes through a BPF2 User Module designed with the handy Filter Design Wizard (accessed by right-clicking the BPF2 module once placed), and then is connected internally to a comparator input. This comparator is, effectively, the bark detector. An interrupt is manually configured to trigger upon the rising edge of the comparator's output.

The software counts the number of comparator triggers it gets in a short period of time. If there are sufficient triggers to constitute a bark, an ultrasonic sweep from 15-19 kHz and down again is produced. In this particular implementation, the speaker is also used as the microphone – and the PSoC switches from an analog input to a strong digital output to produce the sound, and back again to listen for more. A pull-up output is supplied for an LED indicator.

The PSoC code, illustrated in Figure 2, demonstrates how all this might be achieved in practice. A flowchart of the code is shown in Figure 3, and the configuration of PSoC resources appear in Figure 4, Figure 5, Figure 6, and Figure 7.

Figure 1. Schematic



Hardware Implementation

R_1 and C_1 isolate and filter the AGND reference so that both PGAs can use it while operating as a microphone. The PGAs act as a buffer while operating as a speaker. C_2 blocks DC and allows R_2 to restore the AGND offset so maximum gain can be set on both stages. Three 1.5V batteries, AAA in the prototypes case, power the PSoC, even though it is set to 3.3V. The idle current is about 10 mA, and about 50 mA per bark for 2 seconds. The LED is sourced through an internal pull-up resistor to limit current.

Code 1. PSoC C Code

```
#include <m8c.h>        //Part-specific constants and macros
#include "PSoCAPI.h"    //PSoC API definitions for all User Modules
#include "ports.h"
#include "globalparams.h"
       #define Bit(bitNumber)              ( 1 << (bitNumber) )
       void Wait(long int); long int Counter = 0;
#define UltrasonicPeriodMax 100  //for 15kHz min freq w/24V2 clock = 24MHz/16
#define UltrasonicPeriodMin 79   //for 19kHz max freq w/24V2 clock = 24MHz/16
#define UltrasonicToneChangeDelay 200
#define BarkTriggerTimeout 100
#define NumTriggers 20     //Number of comparator edges requred to constitute a bark
#define DriveModeSwitchDelay 500
#define Squeal(b) (PRT2DR = (b==0) ? (PRT2DR&0x7F) : (PRT2DR|0x80))      //P2_7
char UltrasonicPeriod;
char Barking=0;
char PrevBarkCount=0;
void UltrasonicSqueal(void);
void main()
{
       Squeal(0);
       CNT16_Filter_DisableInt();
       CNT16_Filter_Start();
       PGA_Ref_Start(PGA_Ref_HIGHPOWER);
       PGA_Audio_Start(PGA_Audio_HIGHPOWER);
       PGA_Audio2_Start(PGA_Audio2_HIGHPOWER);
       BPF2_Audio_Start(BPF2_Audio_HIGHPOWER);
       CMP_Audio_Start(CMP_Audio_HIGHPOWER);
       CNTTone_DisableInt();
       M8C_EnableIntMask(INT_MSK0,INT_MSK0_ACOLUMN_3);      //Comparator interrupt
       M8C_EnableGInt;
       while(1)
       {
              if (Barking)
              {
                     PrevBarkCount=Barking;
                     Wait(BarkTriggerTimeout);
                     if (Barking==PrevBarkCount) Barking=0;
                     if (Barking>NumTriggers)
                     {
                            Barking=0;
                            UltrasonicSqueal();
                     }
              }
       }
}
void UltrasonicSqueal()
{
       Squeal(1);
       PGA_Audio_Stop();
       PRT0DM0 = PORT_0_DRIVE_0 | Bit(1);
       PRT0DM1 = PORT_0_DRIVE_1 & ~Bit(1);
       PRT0GS = PORT_0_GLOBAL_SELECT | Bit(1);
       UltrasonicPeriod=UltrasonicPeriodMax;
       CNTTone_WritePeriod(UltrasonicPeriod);
       CNTTone_WriteCompareValue(UltrasonicPeriod/2);
       CNTTone_Start();
       Wait(UltrasonicToneChangeDelay);
       while(UltrasonicPeriod>UltrasonicPeriodMin)
       {
              CNTTone_WritePeriod(--UltrasonicPeriod);
              CNTTone_WriteCompareValue(UltrasonicPeriod/2);
              Wait(UltrasonicToneChangeDelay);
```

```
        }
        while(UltrasonicPeriod<UltrasonicPeriodMax)
        {
                CNTTone_WritePeriod(++UltrasonicPeriod);
                CNTTone_WriteCompareValue(UltrasonicPeriod/2);
                Wait(UltrasonicToneChangeDelay);
        }
        CNTTone_Stop();
        PRT0DM0 = PORT_0_DRIVE_0 & ~Bit(1);
        PRT0DM1 = PORT_0_DRIVE_1 | Bit(1);
        PRT0GS = PORT_0_GLOBAL_SELECT & ~Bit(1);
        Wait(DriveModeSwitchDelay);
        PGA_Audio_Start(PGA_Audio_HIGHPOWER);
        Barking=0;
        Squeal(0);
}
#pragma interrupt_handler BarkINT
void BarkINT()
{
        Barking++;
}
void Wait(long int ToWait){for(Counter = 0; Counter < ToWait; Counter++);}
```

Figure 2. Program Flowchart

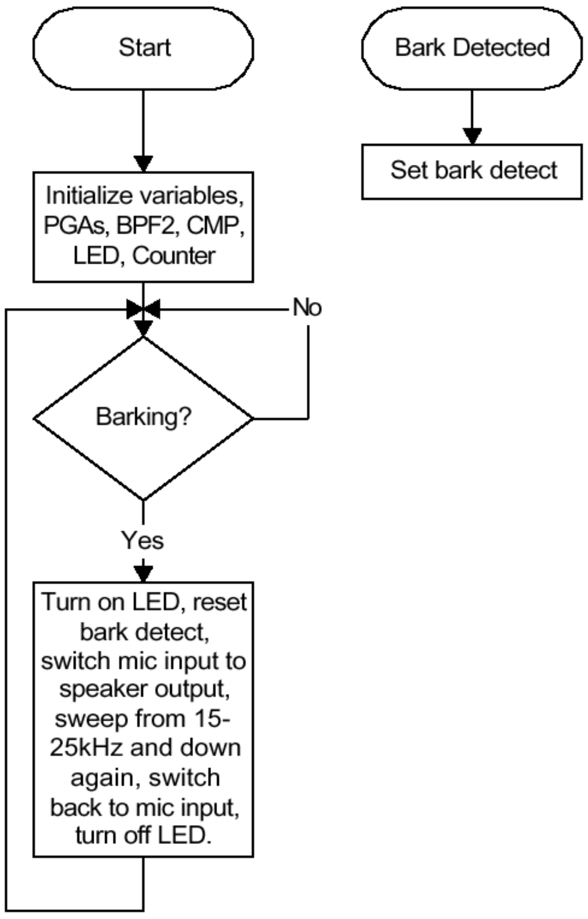

Start
Bark Detected
Set bark detect
Initialize variables, PGAs, BPF2, CMP, LED, Counter
No
Barking?
Yes
Turn on LED, reset bark detect, switch mic input to speaker output, sweep from 15-25kHz and down again, switch back to mic input, turn off LED.

Figure 3. PSoC Pin Configuration

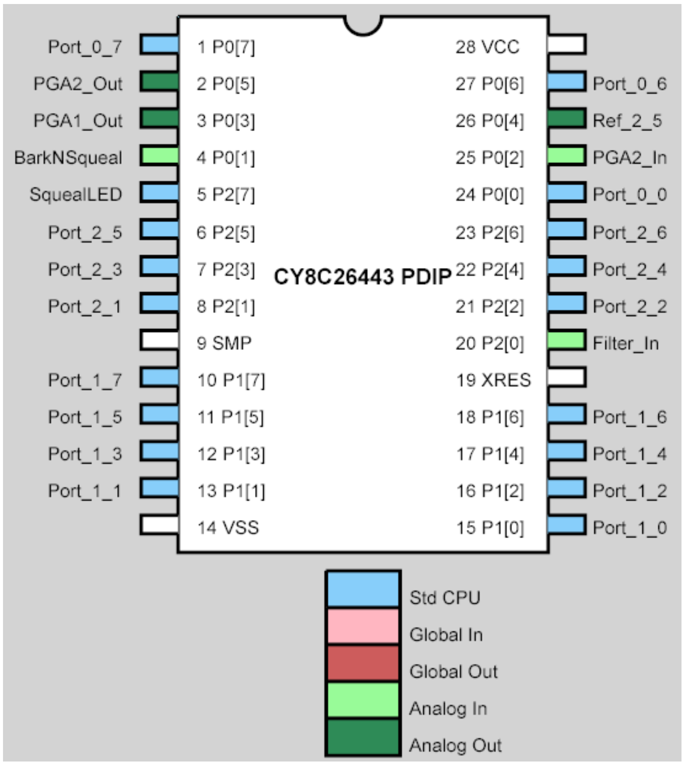


Figure 4. PSoC User Module Configuration

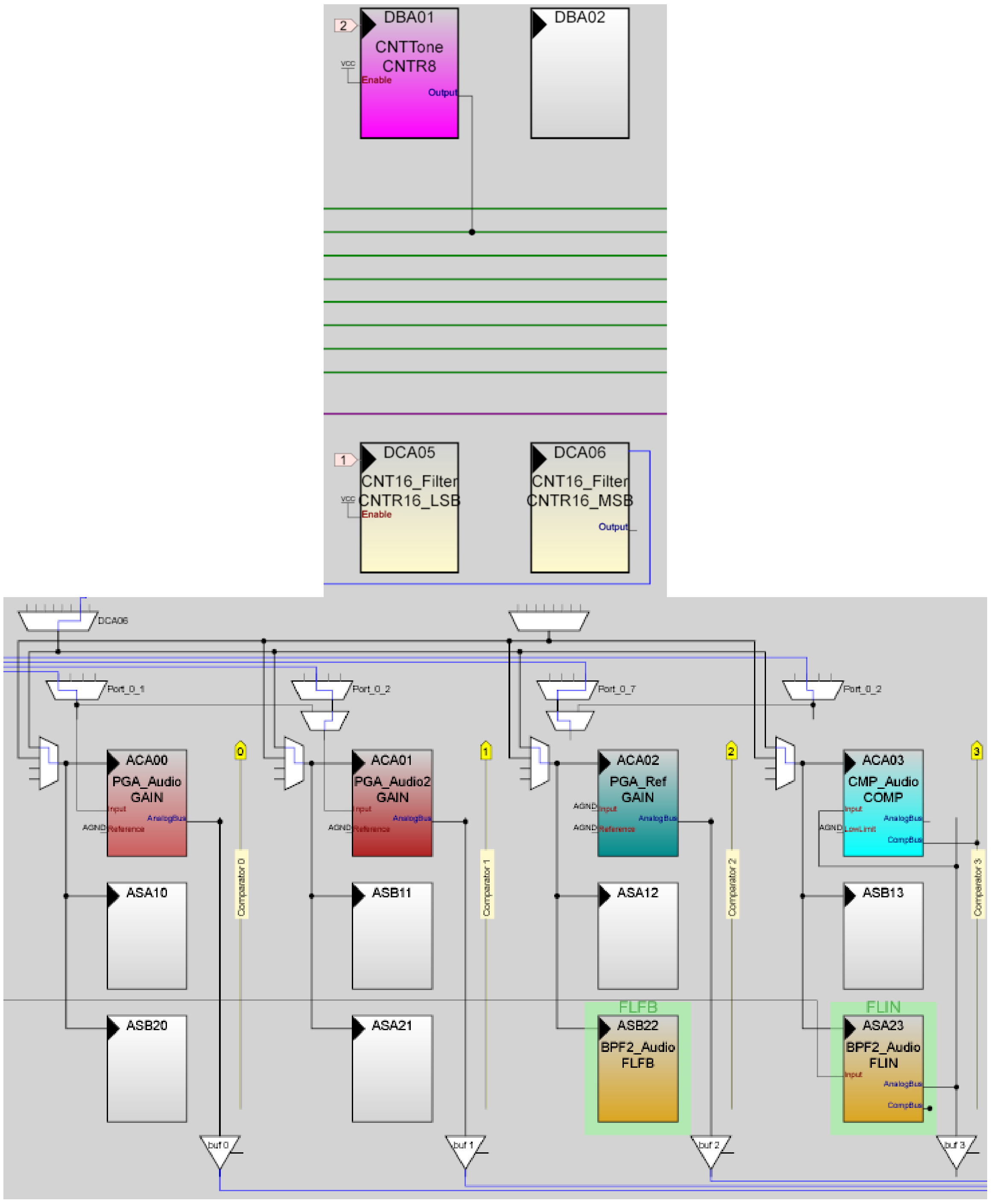


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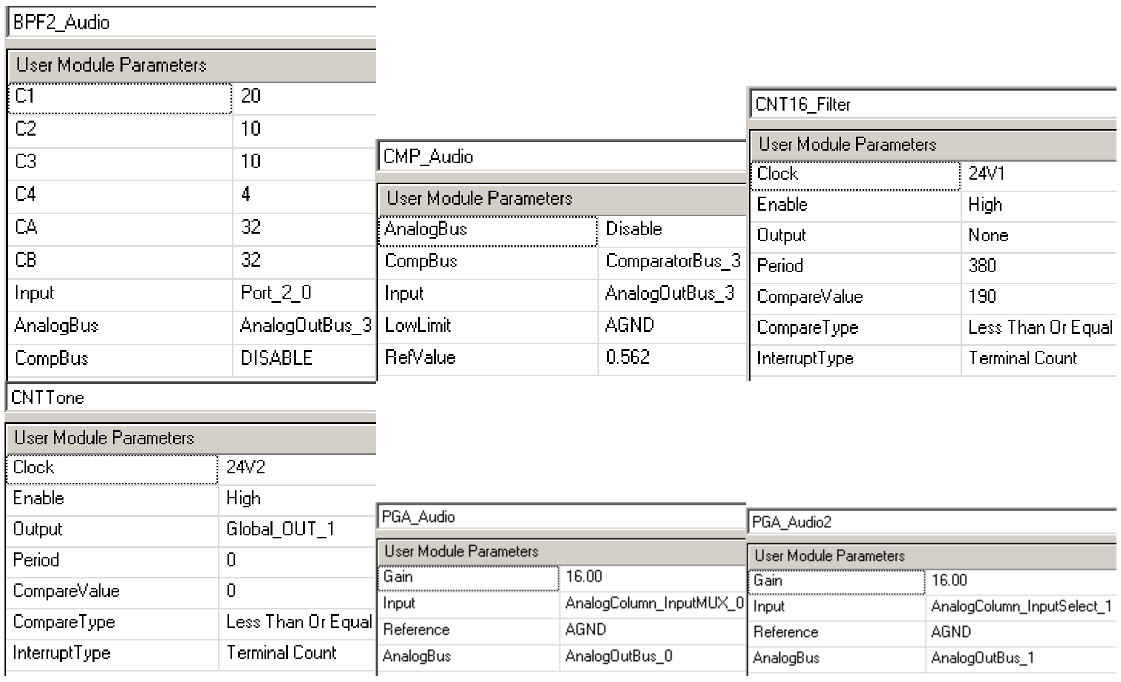
Figure 5. PSoC User Module Parameter Settings



BPF2_Audio

User Module Parameters	
C1	20
C2	10
C3	10
C4	4
CA	32
CB	32
Input	Port_2_0
AnalogBus	AnalogOutBus_3
CompBus	DISABLE

CMP_Audio

User Module Parameters	
AnalogBus	Disable
CompBus	ComparatorBus_3
Input	AnalogOutBus_3
LowLimit	AGND
RefValue	0.562

CNT16_Filter

User Module Parameters	
Clock	24V1
Enable	High
Output	None
Period	380
CompareValue	190
CompareType	Less Than Or Equal
InterruptType	Terminal Count

CNTTone

User Module Parameters	
Clock	24V2
Enable	High
Output	Global_OUT_1
Period	0
CompareValue	0
CompareType	Less Than Or Equal
InterruptType	Terminal Count

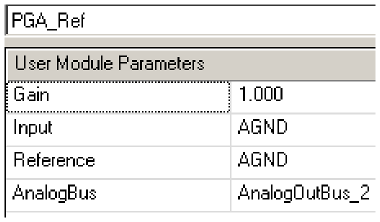
PGA_Audio

User Module Parameters	
Gain	16.00
Input	AnalogColumn_InputMUX_0
Reference	AGND
AnalogBus	AnalogOutBus_0

PGA_Audio2

User Module Parameters	
Gain	16.00
Input	AnalogColumn_InputSelect_1
Reference	AGND
AnalogBus	AnalogOutBus_1

Figure 6. PSoC Global Resource Settings



PGA_Ref

User Module Parameters	
Gain	1.000
Input	AGND
Reference	AGND
AnalogBus	AnalogOutBus_2

About the Authors

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In March of 2007, Cypress recataloged all of its Application Notes using a new documentation number and revision code. This new documentation number and revision code (001-xxxxx, beginning with rev. **), located in the footer of the document, will be used in all subsequent revisions.

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