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//Arduino Function Generator
//by Amanda Ghassaei
//instructables.com/amandaghassaei
//April 2012

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//in most of this code I have used the arduino portpin assignments to send data to pins, you can read more about how that works here: http://www.arduino.cc/en/Reference/PortManipulation

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some notes about pin setup:
4 momentary switches control waveshape (analog in 0-3)
  -sine connects to A0
  -triangle A1
  -saw A2
  -pulse A3
freq control pot (log taper) is connected to analog in 4
pulse width modulation pot (linear taper) connected to anolog in 5
PORT D (digital pins 0-7) are 8 bit function out

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```
//wavetype storage:
//0 is pulse
//1 is triangle
//2 is saw
//3 is sine
byte type = 0;//initialize as square
```

```
byte typecurrent = 8;
byte typelast;
byte typecounter[4];
byte i;

//variables for PW pot monitoring
float pulseWidth;
int pulseWidthScaled;
int PWCurrent;
byte PWTolerance = 8;//adjust this to increase/decrease stability of PW measurement

//variables for freq pot monitoring
int frequency;
int freqCurrent;
byte freqTolerance = 2;//adjust this to increase/decrease stability of frequency measurement
unsigned int freqscaled;

byte wave;
long t;
long samplerate;
long period;

//storage variables- I used these to cut down on the math being performed during the interrupt
int sawByte = 0;
byte sawInc;
int triByte = 0;
byte triInc;
int sinNum = 0;
int sinInc;

void setup() {

  //set port/pin  mode
  DDRD = 0xFF;//all outputs
  DDRC = 0x00;//all inputs
  DDRB = 0xFF;//all outputs
  //TIMER INTERRUPT SETUP

  cli();//disable interrupts
  //timer 1:
  TCCR1A = 0;// set entire TCCR1A register to 0
  TCCR1B = 0;// same for TCCR1B
  //set compare match register- 100khz to start
  OCR1A = 159; // = (16 000 000 / 100 000) - 1 = 159
  //turn on CTC mode
  TCCR1B |= (1 << WGM12);
  // Set CS10 bit for 0 prescaler
  TCCR1B |= (1 << CS10);
  // enable timer compare interrupt
  TIMSK1 |= (1 << OCIE1A);

  samplerate = 100000;

  PORTB = 0;
```

```
  PORTB = 1<<type;

  //initialize variables
  frequency = analogRead(A5);//initialize frequency
  freqscaled = 48*frequency+1;//from 1 to ~50,000\
  period = samplerate/freqscaled;

  pulseWidth = analogRead(A4);//initalize pulse width
  pulseWidthScaled = int(pulseWidth/1023*period);

  triInc = 511/period;
  sawInc = 255/period;
  sinInc = 20000/period;

  sei();//enable interrupts
}

void checkFreq() {
  freqCurrent = analogRead(A5);
  if (abs(freqCurrent-frequency)>freqTolerance){//if reading from pot exceeds tolerance
    frequency = freqCurrent;//new frequency- number between 0 and 1024
    freqscaled = 48*frequency+1;//from 1 to ~50,000
    period = samplerate/freqscaled;
    pulseWidthScaled = int(pulseWidth/1023*period);
    triInc = 511/period;
    if (triInc==0){
      triInc = 1;
    }
    sawInc = 255/period;
    if (sawInc==0){
      sawInc = 1;
    }
    sinInc=20000/period;
  }
}

void checkPW() {
  PWCurrent = analogRead(A4);
  if (abs(PWCurrent-pulseWidth)>PWTolerance){//if reading from pot exceeds tolerance
    pulseWidth = PWCurrent;//new pulse width, val between 0 and 1023
    pulseWidthScaled = int(pulseWidth/1023*period);
  }
}



void checkShape() {//debounce and check states of buttons
//  4 momentary switches control waveshape
//   -pulse connects to A0
//   -triangle A1
//   -saw A2
//   -sine A3
  typelast = typecurrent;
if (digitalRead(A0)==LOW){
  typecurrent  = 1;
```

```
}
else if (digitalRead(A1)==LOW){
  typecurrent = 2;
}
else if (digitalRead(A2)==LOW){
  typecurrent = 4;
}
else if (digitalRead(A3)==LOW){
  typecurrent = 8;
}

  for (i=0; i<4; i++){
    if (i==type){
    }
    else{
      if ((typecurrent & (1 << i)) ^ (typelast & (1 << i))){//current diff than prev and debounce
        if ((typecurrent & (1 << i))){//currently depressed
           type = i;//set wave type
        }
        else {
          typecounter[i] = 12;//else set debounce counter to 12
        }
      }
      else if (((typecurrent & (1 << i)) == (typelast & (1 << i )))) {//if current same as prev and diff than debounce
        if (typecounter[i] > 0 && --typecounter[i] == 0) {//decrease debounce counter and check to see if = 0
          if ((typecurrent & (1 << i))){//if debounce counter = 0 toggle debounced state
            type = i;
          }
        }
      }
    }
  }
}



ISR(TIMER1_COMPA_vect){//timer 1 interrupt
  //increment t and reset each time it reaches period
  t += 1;
  if (t >= period){
    t = 0;
  }
  switch (type) {
    case 0://pulse
    if (pulseWidthScaled <= t) {
      wave = 255;
    }
    else{
      wave = 0;
    }
    break;
    case 1://triangle
    if((period-t) > t) {
      if (t == 0){
```

```
      triByte = 0;
     }
     else{
      triByte += triInc;
     }
    }
    else{
     triByte -= triInc;
    }
    if (triByte>255){
     triByte = 255;
    }
    else if (triByte<0){
     triByte = 0;
    }
    wave = triByte;
    break;
    case 2://saw
    if (t=0){
     sawByte=0;
    }
    else{
     sawByte+=sawInc;
    }
    wave = sawByte;
    break;
    case 3://sine
    sinNum = t*sinInc;
    wave = pgm_read_byte_near(sine20000 + sinNum);
    break;
   }

  PORTD = wave;
}

void loop() {
  checkFreq();
  checkShape();
  checkPW();
  PORTB = 1<<type;
}
```