```
//DAC
#include<Wire.h>
#include<Adafruit_MCP4725.h>
#define defaultFreq 1700 //DAC speed
#define freq0 5000  // sine wave frequency

Adafruit_MCP4725 dac;
int delay0;

const int zetaLength = 32;
float zeta[zetaLength];
float s[zetaLength];
uint16_t pwmDuty[zetaLength];

void setup()
{
  for(int i=0;i<zetaLength;i++){
    zeta[i] = 360/zetaLength*i;
    }
  Serial.begin(115200);
  //dac.begin(0x62);//default: A1
  dac.begin(0x64);//A2
  //dac.begin(0x60);//A0
  delay0 = (1000000/freq0 -
1000000/defaultFreq)/zetaLength;//calculating delay with respect to
computing+propagation delay
  Serial.print("delay0 is ");
  Serial.println(delay0);

  for (int i = 0; i < zetaLength; i++)
  {
    float radianI = zeta[i]*PI/180;
    s[i] = sin(radianI);
    pwmDuty[i] = (uint16_t)map(s[i]*1000,-1000,1000,0,4095);
    Serial.print(i);
    Serial.print(": ");
    Serial.print(s[i]);
    Serial.print(" ");
    Serial.println(pwmDuty[i]);
  }
}

void loop()
{
  for(int i=0;i<zetaLength;i++)
  {
     dac.setVoltage(pwmDuty[i],false);
     delayMicroseconds(delay0);
    }

}
```

```
//PWM DAC
const int zetaLength=16;
float zeta[zetaLength];
float s[zetaLength];
uint16_t pwmDuty[zetaLength];
int pwmPin = 3;//PWM choices:3, 5, 6, 9, 10, 11
void setup()
{
  for(int i=0;i<zetaLength;i++){
      zeta[i] = 360/zetaLength*i;
    }
  pinMode(pwmPin, OUTPUT);
  Serial.begin(115200);
  for (int i = 0; i < zetaLength; i++)
  {
    float radianI = zeta[i]*PI/180;
    s[i] = sin(radianI);
    pwmDuty[i] = (uint16_t)map(s[i]*1000,-1000,1000,0,255);
    Serial.print(i);
    Serial.print(": ");
    Serial.print(s[i]);
    Serial.print(" ");
    Serial.println(pwmDuty[i]);
  }
}

void loop()
{
  for(int i=0;i<zetaLength;i++)
  {
    //Serial.println(pwmDuty[i]);
    analogWrite(pwmPin, pwmDuty[i]);
    delayMicroseconds(4000);
   }
}
```

```
//CODE BY Qiral: ASK_RX
#define defaultFreq 1700 //DAC speed (Hz)

#define freq0 500

const float A[4] = {};

int delay0;

#define a0min 160
#define a0max 350
#define a1min 400
#define a1max 600
#define a2min 600
#define a2max 800
#define a3min 800
#define a3max 1050

#define r_slope 100

int sum = 0;
int max = 0;
int prev = 0;
bool check = false;
int output = -1;
int count = 0;

void setup() {
  // put your setup code here, to run once:
  Serial.begin(115200);
  Serial.flush();
}

uint16_t last = 0;
uint16_t data = 0;
uint16_t bitCheck = 0;

void loop() {
  // put your main code here, to run repeatedly:
  int tmp = analogRead(A3);
  if ( tmp - prev > r_slope && check == false) // check rising edge
  {
    max = 0;
    check = true;
  }
  if ( tmp > max) // find max amplitude
  {
    max = tmp;
  }
  if ( max - tmp > r_slope ) // falling signal
  {
    if (check == true) {
      if ( a0min < max and max < a0max ) {
        //Serial.print("0 0 ");
        last = 0;
        count++;
```

```
      }
      else if ( a1min < max and max < a1max ) {
        //Serial.print("0 1 ");
        last = 1;
        count++;
      }
      else if ( a2min < max and max < a2max ) {
        //Serial.print("1 0 ");
        last = 2;
        count++;
      }
      else if ( a3min < max and max < a3max ) {
        //Serial.print("1 1 ");
        last = 3;
        count++;
      }

      if ( count == 5 ) // 5 cycle / baud
      {
        data |= last << (bitCheck * 2);
        bitCheck++;
        if (bitCheck == 4) {
          Serial.print((char)data);
          data = 0;
          bitCheck = 0;
        }
        //Serial.println();
        count = 0;
      }
    }
    check = false;
  }
  prev = tmp;
}
```

```
//ASK_TX
#include<Wire.h>
#include<String.h>
#include<Adafruit_MCP4725.h>
Adafruit_MCP4725 dac;

#define defaultFreq 1700
#define freq0 500
const float A[4] = {1,2,3,4};//amplitude for each baud type
(00,01,10,11)
const uint16_t S_DAC[4] = {500,1000,500,0};//generate sine wave with
12bits (max at 5V)
int delay0;
char inData[20];
void setup() {
  dac.begin(0x64);
  delay0 = (1000000 / freq0 - 1000000 / defaultFreq) / 4;
  Serial.begin(115200);
  Serial.flush();
}

void loop() {
  if (Serial.available() > 0) {
    int counter = 0;
    String inp = Serial.readString();
    inp += "\n";
    for(int i=0;i<inp.length();i++){
        inData[i]=inp[i];
        counter++;
      }
    //Serial.println(inData);
    for (int i=0;i<counter-1;i++) {//send data
      char preShifted = inData[i];
      for (int k = 7; k > 0; k -= 2) {//send 8 bits from LSB tp MSB
        int tmp = inData[i] & 3;
        for (int sl=0;sl<5;sl++) {//5 cycles/baud
          for (int s=0;s<4;s++) {//4 sample/cycle
//            Serial.print(i);
//            Serial.print("\tchar ");
//            Serial.println(preShifted);
//            Serial.print("\tindex ");
//            Serial.println(tmp);
//            Serial.println(A[tmp]*S_DAC[s]);
            dac.setVoltage(A[tmp]*S_DAC[s], false);//modify
amplitude
            delayMicroseconds(delay0);
          }
        }
        inData[i]>>=2;
      }
    }
    dac.setVoltage(0,false);
  }
}
```

```
//CODE BY Qiral: FSK_RX
#ifndef cbi
#define cbi(sfr, bit)(_SFR_BYTE(sfr)&=~_BV(bit))
#endif
#ifndef sbi
#define sbi(sfr, bit)(_SFR_BYTE(sfr)|=_BV(bit))
#endif

//edit this number
#define r_slope 200

void setup() {
  sbi(ADCSRA, ADPS2); // this for increase analogRead speed
  cbi(ADCSRA,ADPS1);
  cbi(ADCSRA,ADPS0);
  Serial.begin(115200);
  Serial.flush();
}

int prev = 0;
int count = 0;

uint16_t baud_check = 0;
uint16_t data = 0;
uint16_t bit_check = -1;

bool check_amp = false;
bool check_baud = false;

uint32_t baud_begin = 0;

void loop() {
  int tmp = analogRead(A3);

  if ( tmp > r_slope and prev < r_slope and !check_amp ) // check
amplitude
  {
    check_amp = true; // is first max amplitude in that baud
    if ( !check_baud )
    {
      baud_begin = micros();
      bit_check++;
    }
  }

  if(tmp < r_slope and check_baud) {
    if (micros() - baud_begin > 9900 ) // full baud
    {
      uint16_t last = (((count - 5) / 3) & 3) << (bit_check * 2);;
// shift data
      data |= last;
// add two new bits in data
      baud_check++;
      if (baud_check == 4) // 8 bits
      {
        Serial.print((char)data);
```

```
        data = 0;
        baud_check = 0;
        bit_check = -1;
      }
      check_baud = false;
      count = 0;
    }
  }

  if(tmp > r_slope and check_amp) {
    count++;
    check_baud = true;
    check_amp = false;
  }
  prev = tmp;
}
```

```
//FSK_TX
#include<Wire.h>
#include<Adafruit_MCP4725.h>
#include<Adafruit_ADS1015.h>

#define defaultFreq 1700
#define f0 500
#define f1 800
#define f2 1100
#define f3 1400
int delay0, delay1, delay2, delay3;

const uint16_t S_DAC[4] = {1000, 2000, 1000, 0};  // 10 bits input
Adafruit_MCP4725 dac;

void setup()
{
  dac.begin(0x64);//A2
  delay0 = (1000000 / f0 - 1000000 / defaultFreq) / 4;
  delay1 = (1000000 / f1 - 1000000 / defaultFreq) / 4;
  delay2 = (1000000 / f2 - 1000000 / defaultFreq) / 4;
  delay3 = (1000000 / f3 - 1000000 / defaultFreq) / 4;
  Serial.begin(115200);
  Serial.flush();
}

char inData[30];
void loop()
{
  if (Serial.available() > 0)
  {
    int counter = 0;
    String inp = Serial.readString();
    inp += "\n";
    for(int i=0;i<inp.length();i++)
    {
      inData[i] = inp[i];
      counter++;
    }
//    Serial.println(inp);
//    Serial.println(counter);
    for (int i=0;i<counter-1;i++) //send data
    {
      //char preShifted = inData[i];

      for (int k = 7; k > 0; k -= 2) //send 8 bits from LSB tp MSB
      {
        int tmp = inData[i] & 3;
      int useDelay,cyc;
        if(tmp == 0)
        {
          //Serial.println("00");
          cyc = 5;
          useDelay = delay0;
        }
        else if(tmp == 1)
```

```
        {
          //Serial.println("01");
          cyc = 8;
          useDelay = delay1;
        }
        else if(tmp == 2)
        {
          //Serial.println("10");
          cyc = 11;
          useDelay = delay2;
        }
        else
        {
          //Serial.println("11");
          cyc = 14;
          useDelay = delay3;
        }
        for (int sl=0;sl<cyc;sl++)
        {
          for (int s=0;s<4;s++) //4 sample/cycle
          {
            dac.setVoltage(S_DAC[s], false);//modify amplitude
            delayMicroseconds(useDelay);
          }
        }
        inData[i]>>=2;
      }
    }

    dac.setVoltage(0, false);
  }

}
```

```
//FM_TX
#include<Wire.h>
#include<Adafruit_MCP4725.h>
#include<Adafruit_ADS1015.h>

#define defaultFreq 1700
#define f0 100
#define f1 600
#define f2 1100
#define f3 1650
int delay0, delay1, delay2, delay3;

const uint16_t S_DAC[4] = {0, 1000, 2000, 1000};  // 10 bits input
Adafruit_MCP4725 dac;

void setup()
{
  dac.begin(0x64);//A2
  delay0 = (1000000 / f0 - 1000000 / defaultFreq) / 4;
  delay1 = (1000000 / f1 - 1000000 / defaultFreq) / 4;
  delay2 = (1000000 / f2 - 1000000 / defaultFreq) / 4;
  delay3 = (1000000 / f3 - 1000000 / defaultFreq) / 4;
  Serial.begin(115200);
  Serial.flush();
}

char inData[15];
void loop()
{
  if (Serial.available() > 0)
  {
    int counter = 0;
    String inp = Serial.readString();
    inp += "\n";
    for (int i = 0; i < inp.length(); i++)
    {
      inData[i] = inp[i];
      counter++;
    }
    //    Serial.println(inp);
    //    Serial.println(counter);
    for (int s = 0; s < 4; s++) //DUMMY SIGNAL
    {
      dac.setVoltage(1000, false);//modify amplitude
      delayMicroseconds(delay0);
    }
    for (int i = 0; i < counter; i++) //send data
    {
      //char preShifted = inData[i];

      for (int k = 7; k > 0; k -= 2) //send 8 bits from LSB tp MSB
      {
        int tmp = inData[i] & 3;
        int useDelay, cyc;
        if (tmp == 0)
        {
```

```
          //Serial.println("00");
          cyc = 1;
          useDelay = delay0;
        }
        else if (tmp == 1)
        {
          //Serial.println("01");
          cyc = 6;
          useDelay = delay1;
        }
        else if (tmp == 2)
        {
          //Serial.println("10");
          cyc = 11;
          useDelay = delay2;
        }
        else
        {
          //Serial.println("11");
          cyc = 16;
          useDelay = delay3;
        }

        for (int sl = 0; sl < cyc; sl++)
        {
          for (int s = 0; s < 4; s++) //4 sample/cycle
          {
            dac.setVoltage(S_DAC[s], false);//modify amplitude
            delayMicroseconds(useDelay);
          }
        }
        inData[i] >>= 2;
      }
    }
for (int s = 0; s < 4; s++) //DUMMY SIGNAL
    {
      dac.setVoltage(1000, false);//modify amplitude
      delayMicroseconds(delay0);
    }
    dac.setVoltage(0,false);

  }

}
```

```
//CODE BY Qiral: FM_RX

#ifndef cbi
#define cbi(sfr, bit)(_SFR_BYTE(sfr)&=~_BV(bit))
#endif
#ifndef sbi
#define sbi(sfr, bit)(_SFR_BYTE(sfr)|=_BV(bit))
#endif

//edit this number
#define r_slope 200

void setup() {
  sbi(ADCSRA, ADPS2); // this for increase analogRead speed
  cbi(ADCSRA,ADPS1);
  cbi(ADCSRA,ADPS0);
  Serial.begin(115200);
  Serial.flush();
}

int prev = 0;
int count = 0;

uint16_t baud_check = 0;
uint16_t data = 0;
uint16_t bit_check = -1;

bool check_amp = false;
bool check_baud = false;

uint32_t baud_begin = 0;

void loop() {
  int tmp = analogRead(A3);

  if ( tmp > r_slope and prev < r_slope and !check_amp ) // check
amplitude
  {
    check_amp = true; // is first max amplitude in that baud
    if ( !check_baud )
    {
      baud_begin = micros();
      bit_check++;
    }
  }

  if(tmp < r_slope and check_baud) {
    if (micros() - baud_begin > 9900 ) // full baud
    {
      uint16_t last = (((count - 5) / 3) & 3) << (bit_check * 2);;
// shift data
      data |= last;
// add two new bits in data
      baud_check++;
      if (baud_check == 4) // 8 bits
      {
```

```
        Serial.print((char)data);
        data = 0;
        baud_check = 0;
        bit_check = -1;
      }
      check_baud = false;
      count = 0;
    }
  }

  if(tmp > r_slope and check_amp) {
    count++;
    check_baud = true;
    check_amp = false;
  }
  prev = tmp;
}
```