

Arduino-AD9850-DDS

Der AD9850 ([Datenblatt](#)) ist ein DDS, der ein Sinussignal von 0-40MHz erzeugen kann.

In diesem Projekt wird er von einem Arduino Nano angesteuert.

Die Frequenzeinstellung sowie die Quartz-Kalibration erfolgt mit einem Drehencoder und einem I2C-Textdisplay (16x2). Die eingestellten Werte können im Arduino-EEPROM gespeichert werden.



Verdrahtung am Arduino		
Modul	Pin Name	Arduino Pin
I2C-Textdisplay	SDA	A4
	SCL	A5
DrehEncoder	CLK	D2
	DT	D3
(Button)	SW	D4 (mit 10kOhm zu VCC)
AD9850	W_CLK	D5
	FU_UD/FQ_UD	D6
	Data	D7
	Reset	D8

Benutzte Bibliotheken:

- Drehencoder: Encoder http://www.pjrc.com/teensy/td_libs_Encoder.html Copyright © 2011,2013 PJRC.COM, LLC - Paul Stoffregen paul@pjrc.com
- EEPROMex <http://thijs.elenbaas.net/2012/07/extended-eprom-library-for-arduino/> Copyright © 2012 Thijs Elenbaas, GNU LGPL
- zum Teil integriert (muss nicht installiert werden, hier nur als Referenz) AD9850 <https://github.com/F4GOJ/AD9850> Created 23/08/2014, Christophe Caiveau f4goj@free.fr, Public Domain

Kurze Warnung vorab: ich bin kein Programmierer und es gibt die ein oder andere Stelle, die man noch verbessern könnte*. Auch wenn der Code gut funktioniert, bin ich für jeden Tip per Mail an danielwf@hackerspace-bremen.de dankbar - man lernt ja schließlich nie aus ;)



**Todo*: Serielle Frequenzeingabe; DrehEncoder-Eingabe tlw. ungenau; EEPROM-Update wird immer geschrieben, wenn der Mode geändert wird → Nur schreiben, wenn sich der Wert im EEPROM auch wirklich geändert hat.

Das gesamte Projekt inkl. Libraries kann [hier als zip-Archiv](#) heruntergeladen werden.

Arduino-Sketch Arduino-AD9850-DDS.ino (Arduino 1.6.9, Stand 17.11.2016)

```
//
//  .-----
//  .-----
//  |
//  | Arduino-AD9850-DDS
//  |
//  | '-----
//  |
//  |
//  | by Daniel Wendt-Fröhlich, DL2AB (danielwf@hackerspace-bremen.de,
//  | dl2ab@darc.de) for
//  | "Hackerspace Bremen e.V." https://hackerspace-bremen.de / HSHB
//  | Amateur Radio Group http://hshb.de/afu
//  | License CC-by-SA 3.0 - Nov 2016 - Bremen(GER) --
//  | http://creativecommons.org/licenses/by-sa/3.0/de/
//  |
//  | Frequency selectable with push button
//  | rotary encoder
//  | incl. XTAL-calibration and saving
//  | values to EEPROM
//  | Used Libraries:
//  | Encoder http://www.pjrc.com/teensy/td\_libs\_Encoder.html Copyright (c)
//  | 2011,2013 PJRC.COM, LLC - Paul Stoffregen <paul@pjrc.com>
//  | EEPROMex
//  | http://thijs.elenbaas.net/2012/07/extended-EEPROM-library-for-arduino/
//  | Copyright (c) 2012 Thijs Elenbaas, GNU LGPL
//  | in parts AD9850 https://github.com/F4GOJ/AD9850 Created 23/08/2014,
//  | Christophe Caiveau f4goj@free.fr, Public Domain
//  |
//  |
//  | todo: set frequency via serial interface, better rotary encoder
//  | detection, EEPROM-Update only if values have really changed.
//  |
//  | -----Connections-----
//  |
```

```

//      Display SDA: A4 (check/modify 'LiquidCrystal_I2C lcd' for your
used I2C-LCD-Adapter, I2C-Adress, PinOut)
//      Display SCL: A5
//
//      Rotary CLK: D2 (check/modify encResolution for your rotary
encoder)
//      Rotary DT: D3
// Button/Rotary SW: D4 (with 10k-PullUp to VCC)
//
//      AD9850 W_CLK: D5
//      AD9850 FU_UD: D6
//      AD9850 Data: D7
//      AD9850 Reset: D8
//
//      ,-----
-----
-----,
//      |                                                    Libraries
and Settings
|
//      '-----
-----
-----'

//
Frequencies used when no stored values are found (or are 0)
double ddsFreq = 14070000; // DDS
Standard frequency
double calibFreq = 125000000; // XTAL
Standard frequency
int ddsPhase = 0; //
Phase for DDS (not further used in this project, but need for DDS)

double frequency; //
working values for LCD and modification...
double newfrequency; //
...will be set in setup
byte freqCursor = 0;
byte Mode = 0; // Mode
0=DDS 1=Calibrate

//      -----EEPROM for Double-
Values-----
#include <EEPROMex.h> //
EEPROM-Libs for more simple Double-Handling,
http://thijs.elenbaas.net/2012/07/extended-EEPROM-library-for-arduino/
#include <EEPROMVar.h>
const int eepadrDDS = 10; //
Adresses in EEPROM
const int eepadrCAL = 20;
double eepRead = 0; // read

```

value from EEPROM

```
// -----Display-----  
-----  
#include <Wire.h>  
#include <LiquidCrystal_I2C.h> // I2C-  
LCD-Library, included in Arduino-IDE  
LiquidCrystal_I2C lcd(0x3F, 2, 1, 0, 4, 5, 6, 7, 3, POSITIVE); // Set  
the LCD I2C address, SainSmartLCD2004 0x3F, maybe try 0x38 or 0x20  
bool DisplayRefresh = 1;  
  
// -----Encoder-----  
-----  
#include <Encoder.h> // Encoder  
Library using interrupts, http://www.pjrc.com/teensy/td_libs_Encoder.html  
Encoder myEnc(2, 3); // Pins 2+3  
are usable for Interrupts on the Arduino Nano  
byte oldPosition = 0; // beginning  
position of rotary counter, must be 0  
byte encResolution = 4; // counted  
steps per rotary-step  
int pushButton = 4; // Button is  
connected to Pin 4  
unsigned long rotaryDebounce = millis() + 100; // removes  
wrong detected/counted movements  
unsigned long buttonDebounce = millis() + 300; // same for  
button (slows down ;)  
byte buttonHold = 0;  
  
int8_t rotaryDirection(){ // returns  
Direction of rotary encoder with -1, 0 oder 1  
    byte i = 0; // default =  
no rotation  
    byte newPosition = myEnc.read(); // reads  
position of encoder-lib  
    if ( newPosition != oldPosition) { // if  
position has changed  
        if ( (newPosition % encResolution == 0) && (millis() >= rotaryDebounce)  
        ) { // calculate real steps according to rotary-resolution and debouncing  
            if (oldPosition > newPosition) i = -1; // return  
value  
            if (oldPosition < newPosition) i = 1;  
            rotaryDebounce = millis() + 100; // timer for  
debouncing  
        }  
        oldPosition = newPosition; // working  
value for calculating further rotations  
    }  
}
```

```

    return i;
}

// -----AD9850-----

// values
and function from https://github.com/F4G0J/AD9850 -- lib cannot be used,
"DATA" is also in I2C-LCD-Lib
const int adPinWCLK = 5;
const int adPinFQUD = 6;
const int adPinDATA = 7;
const int adPinRESET = 8;
uint32_t adDeltaphase; //
calculated value send to AD9850
uint8_t adPhase;

void adSetfreq(double f, uint8_t p) { // function
gets frequency and phase
    adDeltaphase = f * 4294967296.0 / calibFreq; //
calculation for value to send
    adPhase = p << 3; // bitshift
for phase
    for (int i=0; i<4; i++, adDeltaphase>=>8) { // shift out
the double (=4bytes) via DDS-pins
        shiftOut(adPinDATA, adPinWCLK, LSBFIRST, adDeltaphase & 0xFF);
    }
    shiftOut(adPinDATA, adPinWCLK, LSBFIRST, adPhase & 0xFF); // shift out
phase-value
    digitalWrite(adPinFQUD, HIGH); digitalWrite(adPinFQUD, LOW); // DDS sets
to sent value after FQUD is up
}

// -----
// | SETUP
// '-----
// -----

void setup() {

    pinMode(pushButton, INPUT); // set pushButton as
input

    Serial.begin(9600); // setup serial

```

connection

```

    lcd.begin(16,2);                                // initialize the 16x2-
lcd, backlight is lit
    lcd.backlight();                                // switch backlight on
    lcd.setCursor(3,0); lcd.print("Arduino-");       // set display-cursor x,y
and print text
    lcd.setCursor(2,1); lcd.print("AD9850-DDS");
    delay(2000);

    lcd.noBacklight();                              // switch backlight off,
no visible screen transistion, better short-term readablity
    lcd.clear();                                    // clear content on
display
    lcd.setCursor(0,0); lcd.print("short: sel.Pos."); // Help-Message
    lcd.setCursor(0,1); lcd.print("hold:save f/cal");
    delay(300);
    lcd.backlight();
    delay(2000);

// -----
EEPROM Reading while Help-Message is still on the display-----
-----
    eepRead = EEPROM.readDouble(eepadrDDS);          // read double from
eeprom for DDS-frequency
    if (eepRead > 0) ddsFreq = eepRead;              // check if empty
(important for new installations) if not, overwrite with stored value
    eepRead = EEPROM.readDouble(eepadrCAL);          // same for Xtal...
    if (eepRead > 0) calibFreq = eepRead;
    frequency = ddsFreq;                            // set working values for
LCD and modification
    newfrequency = frequency;

    lcd.noBacklight();
    lcd.clear();
    lcd.setCursor(0,0); lcd.print("DDS      _");
    lcd.setCursor(0,1); lcd.print("Freq 00000000 Hz");
    delay(300);
    lcd.backlight();

// -----
Initialize the AD9850-DDS -----
    pinMode(adPinWCLK, OUTPUT);                      // set output-pins
    pinMode(adPinFQUD, OUTPUT);
    pinMode(adPinDATA, OUTPUT);
    pinMode(adPinRESET, OUTPUT);
    digitalWrite(adPinRESET, HIGH); digitalWrite(adPinRESET, LOW); // init
the DDS
    digitalWrite(adPinWCLK, HIGH); digitalWrite(adPinWCLK, LOW);
    digitalWrite(adPinFQUD, HIGH); digitalWrite(adPinFQUD, LOW);

```

```
adSetfreq(ddsFreq, ddsPhase); // send values to AD9850
}

// -----
// |                                     LOOP
// '-----
// -----

void loop() {

    int8_t rotaryValue = rotaryDirection();
    // value for last encoder rotation (-1,0,+1)

    // -----Button-----
    if (digitalRead(pushButton)) buttonHold = 0;
    // set Button-Hold-Counter to 0, if button is released
    if (buttonHold >= 10) {
        // if Button-Hold-Counter is 6, set Mode to 1 (Calibration)
        EEPROM.writeDouble(eepadrDDS, ddsFreq);
        // Writes values to EEPROM
        EEPROM.writeDouble(eepadrCAL, calibFreq);
        Mode++;
        // set next Mode
        if (Mode == 2) Mode = 0;
        // There are only modes 0 + 1
        buttonHold = 0;
        // reset counter for button hold
        lcd.clear();
        DisplayRefresh = 1;
        // force rewriting of lcd after mode changed
        if (Mode == 0) frequency = ddsFreq;
        // set the working frequency related to the mode
        if (Mode == 1) frequency = calibFreq;
    }

    if ( (!digitalRead(pushButton)) && (millis() >= buttonDebounce) ) {
        // if button is pressed, debounce-timer (and timer für ButtonHold-Counter)
        freqCursor++;
        // set the cursor to next position
        if (freqCursor == 8) freqCursor = 0;
        // reset cursor if it is bigger than 8
        DisplayRefresh = 1;
        // force rewriting of lcd after something changed
        // lcd.setCursor((12-freqCursor),0); lcd.print("_");
    }
}
```

```
// Cursor-Position on Display
    buttonDebounce = millis() + 300;
// Debounce-Timer
    buttonHold++;
// Button-Hold-counter
}

// -----rotary encoder-----
-----
    if (freqCursor == 0) newfrequency = frequency + (rotaryValue);
// calculates the frequency using Cursor-Position and rotary-encoder
    if (freqCursor == 1) newfrequency = frequency + (rotaryValue * 10);
// the simple way works...
    if (freqCursor == 2) newfrequency = frequency + (rotaryValue * 100);
    if (freqCursor == 3) newfrequency = frequency + (rotaryValue * 1000);
    if (freqCursor == 4) newfrequency = frequency + (rotaryValue * 10000);
    if (freqCursor == 5) newfrequency = frequency + (rotaryValue * 100000);
    if (freqCursor == 6) newfrequency = frequency + (rotaryValue * 1000000);
    if (freqCursor == 7) newfrequency = frequency + (rotaryValue *
10000000);
    if (newfrequency <= 0) newfrequency = 0;
    if (Mode == 0) {
        if (newfrequency <= 0) newfrequency = 0;
// frequency 0-40M with Mode 0
        if (newfrequency >= 40000000) newfrequency = 40000000;
    }

    // Print frequency
// -----Display Frequency-----
-----
    if ( (newfrequency != frequency) || DisplayRefresh ) {
// Only changes the display after frequency-adjustment or DisplayRefresh-Bit
        DisplayRefresh = 0;
        frequency = newfrequency;
// changes the real frequency
        byte freqSize = 0;
// calculates the display size of the frequency
        double freqDec = 10;
        while (freqDec <= frequency) {
            freqSize++;
            freqDec = freqDec * 10;
        }
        if (Mode == 0) { lcd.setCursor(0,0); lcd.print("DDS          "); }
// 1st line on lcd...
        if (Mode == 1) { lcd.setCursor(0,0); lcd.print("Cal          "); }
//          ...related to mode
        lcd.setCursor((12-freqCursor),0); lcd.print("_");
// Cursor-Position on Display
        if (Mode == 0) { lcd.setCursor(0,1); lcd.print("Freq 00000000 Hz"); }
```



```
// 2nd line on lcd...
    if (Mode == 1) { lcd.setCursor(0,1); lcd.print("Xtl 000000000 Hz"); }
//      ...related to mode
    lcd.setCursor( (12-freqSize) ,1);
// set cursor with calculated display size of frequency
    lcd.print(frequency,0);
// print the frequency
    Serial.println(frequency,0);
// serial output of the frequency
    if (Mode == 0) ddsFreq = frequency;
    if (Mode == 1) calibFreq = frequency;
    adSetfreq(ddsFreq, ddsPhase);
// send values to AD9850
    }

}
```

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