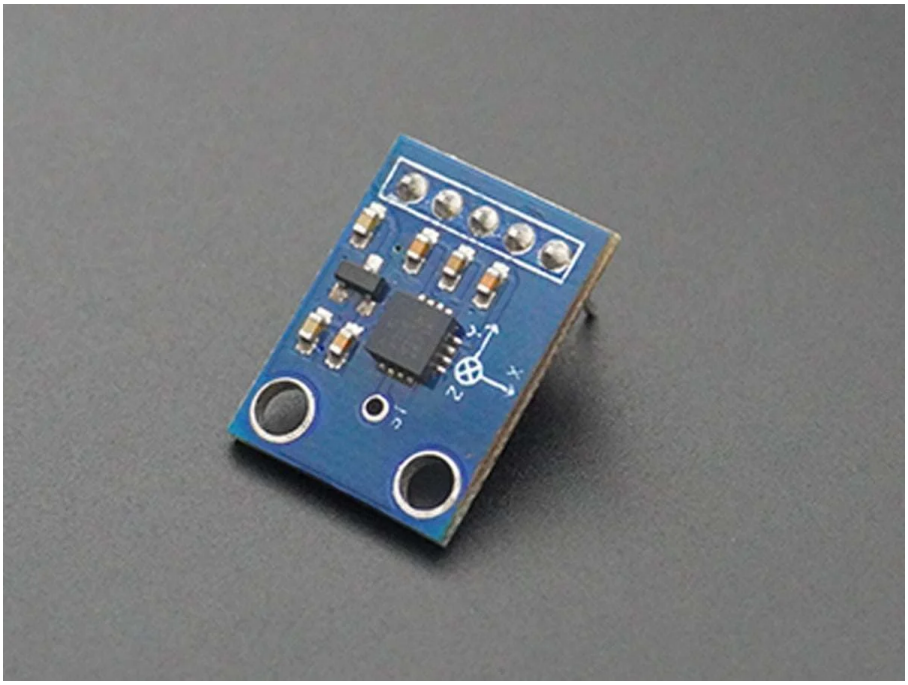
Accelerometer ADXL335 Interfacing with AVR ATmega16

Overview of Accelerometer



An accelerometer is an electromechanical device that measures the force of acceleration due to gravity in g unit.

It can be used for tilt sensing applications (For example: In mobile phones, gaming applications, etc).

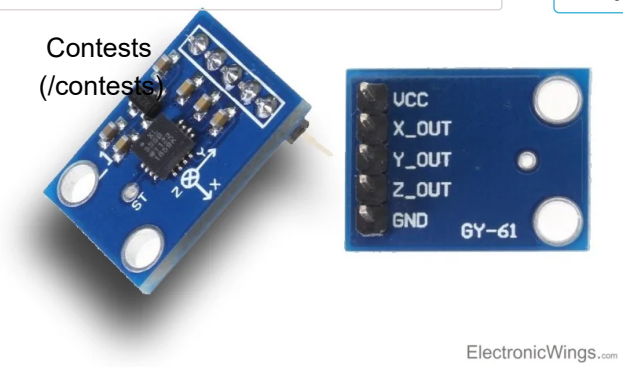
The ADXL335 measures acceleration along X, Y, and Z axes.

It gives analog voltage output proportional to the acceleration along the 3 axes.

These voltages can be converted to a digital signal using ADC and then processed by the microcontroller to find out the tilt.

For more information about the ADXL335 accelerometer and how to use it, refer to the topic **ADXL335 Accelerometer Module** (http://electronicwings.com/sensors-modules/adxl335-accelerometer-module) in the sensors and modules section.

For information about ADC in ATmega16 and how to use it, refer to the topic **ADC in AVR ATmega16/ATmega32** (https://www.electronicwings.com/avr-atmega/atmega1632-adc) in the ATmega inside section.

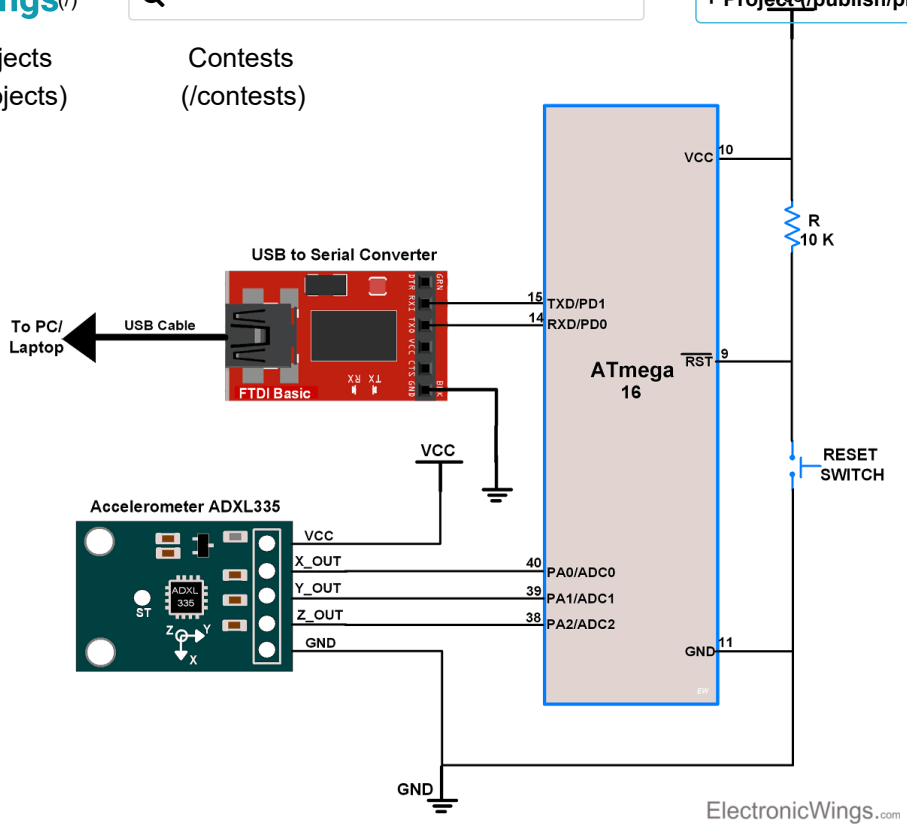


ADXL335 Accelerometer Module

Interfacing Accelerometer ADXL335 with AVR ATmega16

- As the module has an analog output. we will measure it using ADC channels of ATmega16.
- ATmega16 has ADC pins on its PORT A and it has 8 input channels.
- So we will connect X, Y, and Z analog output of the ADXL335 module to three input ADC channels of ATmega16, say channel0, channel1, and channel2 respectively.
- And after reading ADC values of X, Y, and Z from the module, we will send it to the PC/Laptop over USART.

Connection Diagram of ADXL335 with ATmega16/32



Interfacing ADXL335 Accelerometer Module With ATmega 16

Accelerometer ADXL335 Code for ATmega16/32

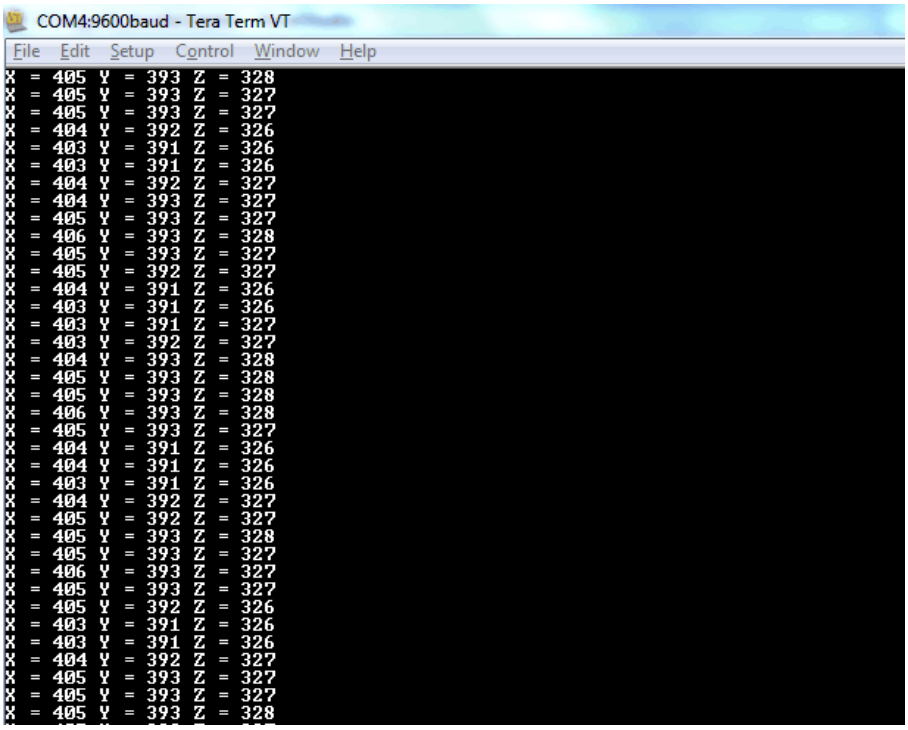
```
/*
 * ATmega16_Accelerometer.c
 * http://www.electronicwings.com
 *
 */

#define F_CPU 8000000UL            /* Define CPU clock Frequency 8MHz */
#include <avr/io.h>            /* Include AVR std. library file */
#include <util/delay.h>            /* Include defined delay header file */
#include <stdio.h>            /* Include standard i/o library file */
#include "USART_RS232_H_file.h"    /* Include USART header file */


void ADC_Init()              /* ADC Initialization function */
{
        DDRA = 0x00;                /* Make ADC port as input */
        ADCSRA = 0x87;              /* Enable ADC, with freq/128  */
        ADMUX = 0x40;               /* Vref: Avcc, ADC channel: 0 */
}

int ADC_Read(char channel)     /* ADC Read function */
{
```

Output Window

On PC/Laptop's serial terminal application, we can see directly X, Y, Z's ADC values as shown in the below figure. For testing tilt the module in X and Y direction and observe the changes in X and Y values.

- If we tilt the module on X-axis, we get variations in X and Z values whereas Y will remain nearly constant.
- If we tilt the module on Y-axis, we get variations in Y and Z values whereas Y will remain nearly constant.

Output window of ADC values.



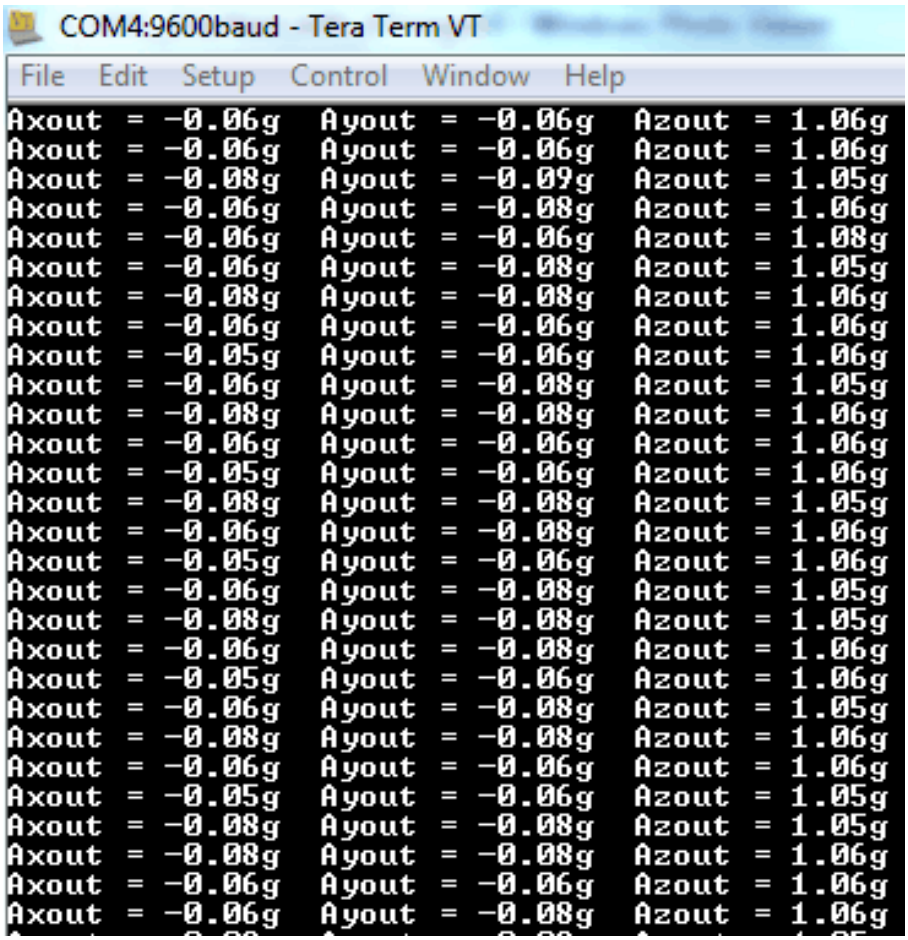
Accelerometer ADXL335 Code for ATmega16/32

Calculate the angle of tilt or inclination using ATmega16 and print on the serial monitor

```
int ADC_Read(char channel)      /* ADC Read function */
{
        ADMUX = 0x40 | (channel & 0x07);        /* set input channel to r
        ADCSRA |= (1<<ADSC);                    /* Start ADC c
        while (!(ADCSRA & (1<<ADIF)));          /* Wait until end of conv
        ADCSRA |= (1<<ADIF);                    /* Clear interru
        _delay_ms(1);                           /* Wa
        return ADCW;                            /* Re
}

void SendSerial(char* str, double value, char unit)
{
        char buffer[10];
        dtostrf(value,4,2,buffer);
        USART_SendString(str);          /* Send Name string */
        USART_SendString(buffer);       /* Send value */
        USART_TxChar(unit);                     /* Send unit char */
        USART_TxChar('\t');                     /* Send tab char */
        _delay_ms(10);
}

int main(void)
```

Output Window

1. **Acceleration in g unit:**



2. **Angle of Inclination**

```
Theta = -3.31°  Psy = -3.31°  Phi = 4.68°
Theta = -3.31°  Psy = -3.31°  Phi = 4.68°
Theta = -4.15°  Psy = -4.96°  Phi = 6.47°
Theta = -3.31°  Psy = -4.10°  Phi = 5.27°
Theta = -3.26°  Psy = -3.26°  Phi = 4.62°
Theta = -3.35°  Psy = -4.16°  Phi = 5.35°
Theta = -4.10°  Psy = -4.10°  Phi = 5.80°
Theta = -3.31°  Psy = -3.31°  Phi = 4.68°
Theta = -2.51°  Psy = -3.31°  Phi = 4.16°
Theta = -3.35°  Psy = -4.16°  Phi = 5.35°
Theta = -4.10°  Psy = -4.10°  Phi = 5.80°
Theta = -3.31°  Psy = -3.31°  Phi = 4.68°
Theta = -2.51°  Psy = -3.31°  Phi = 4.16°
Theta = -4.16°  Psy = -4.16°  Phi = 5.88°
Theta = -3.31°  Psy = -4.10°  Phi = 5.27°
Theta = -2.51°  Psy = -3.31°  Phi = 4.16°
Theta = -3.35°  Psy = -4.16°  Phi = 5.35°
Theta = -4.16°  Psy = -4.16°  Phi = 5.88°
Theta = -3.31°  Psy = -4.10°  Phi = 5.27°
Theta = -2.51°  Psy = -3.31°  Phi = 4.16°
Theta = -3.35°  Psy = -4.16°  Phi = 5.35°
Theta = -4.10°  Psy = -4.10°  Phi = 5.80°
```

3. Angle of Rotation

```
Roll = 176.69°  Pitch = 273.31°  Yaw = 45.00°
Roll = 176.69°  Pitch = 273.31°  Yaw = 45.00°
Roll = 175.03°  Pitch = 274.17°  Yaw = 39.95°
Roll = 175.89°  Pitch = 273.31°  Yaw = 38.88°
Roll = 176.73°  Pitch = 273.27°  Yaw = 45.00°
Roll = 175.83°  Pitch = 273.36°  Yaw = 38.88°
Roll = 175.89°  Pitch = 274.11°  Yaw = 45.00°
Roll = 176.69°  Pitch = 273.31°  Yaw = 45.00°
Roll = 176.69°  Pitch = 272.52°  Yaw = 37.22°
Roll = 175.83°  Pitch = 273.36°  Yaw = 38.88°
Roll = 175.89°  Pitch = 274.11°  Yaw = 45.00°
Roll = 176.69°  Pitch = 273.31°  Yaw = 45.00°
Roll = 176.69°  Pitch = 272.52°  Yaw = 37.22°
Roll = 175.83°  Pitch = 274.17°  Yaw = 45.00°
Roll = 175.89°  Pitch = 273.31°  Yaw = 38.88°
Roll = 176.69°  Pitch = 272.52°  Yaw = 37.22°
Roll = 175.83°  Pitch = 273.36°  Yaw = 38.88°
Roll = 175.83°  Pitch = 274.17°  Yaw = 45.00°
Roll = 175.89°  Pitch = 273.31°  Yaw = 38.88°
Roll = 176.69°  Pitch = 272.52°  Yaw = 37.22°
Roll = 175.83°  Pitch = 273.36°  Yaw = 38.88°
Roll = 175.89°  Pitch = 274.11°  Yaw = 45.00°
Roll = 176.69°  Pitch = 273.31°  Yaw = 45.00°
```

Video of Object Movement using an Accelerometer with ATmega16/32

Components Used

Powered By MOUSER ELECTRONICS (https://www.mouser.in?utm_source=electronicswings&utm_medium=display&utm_campaign=mouser-componentslisting&utm_content=0x0)

ATmega 16 ATmega 16	X 1	(https://www.mouser.in/ProductDetail/Microchip-Technology-Atmel/ATMEGA16L-8PU?qs=%2Fha2pyFaduiGCJtTvs2wv8fVZbVAalLu7Iq%2FglTS0tALAx6fMenLvg%3D%3D&utm_source=electronicswings&utm_medium=display&utm_campaign=mouser-componentslisting&utm_content=0x0) Datasheet (/components/atmega-16/1/datasheet)

Components Used

Atmega32 Atmega32	X 1	(https://www.mouser.in/ProductDetail/Microchip-Technology-Atmel/ATMEGA32-16PU?qs=aqrrBurbvGdpkmgj7RWmsQ%3D%3D&utm_source=electronicswings&utm_medium=display&utm_campaign=mouser-componentslisting&utm_content=0x0) Datasheet (/components/atmega32/1/datasheet)
ADXL335 Accelerometer Module Accelerometer ADXL335 sensor measures accelerat...	X 1	(https://www.mouser.com/ProductDetail/SparkFun/SEN-09269?qs=%2Fha2pyFaduirpHjDiRZBAeqLmhln74eejkteGKGGiMoRJMMcbKIwXA%3D%3D&utm_source=electronicswings&utm_medium=display&utm_campaign=mouser-componentslisting&utm_content=0x0) Datasheet (/components/adxl335-accelerometer-module/1/datasheet)

Components Used

CP2103 USB TO UART BRIDGE CP2103 is single chip USB to UART Bridge. It su...	X 1	(https://www.mouser.com/ProductDetail/Silicon-Labs/CP2103-GMR?qs=Zq62GxwlckYrXEgTuxpNRg%3D%3D&utm_source=electronicswings&utm_medium=display&utm_campaign=mouser-componentslisting&utm_content=0x0) Datasheet (/components/cp2103-usb-to-uart-bridge/1/datasheet)

Downloads

ATmega16 Accelerometer Project file	Dow nloa d (/api/download/platform-attachment/146)
ADXL335 Datasheet	Dow nloa d (/api/download/platform-attachment/147)
Accelerometer Application Note	Dow nloa d (/api/download/platform-attachment/148)

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