

a

## ADXL202 Evaluation Board with RS-232 Interface and Datalogging.

ADXL202EB-232A

### FEATURES

Evaluation board with ADXL202, Microchip  
16C63

Two axis acquisition of acceleration or tilt  
information

PC Data acquisition software

275Hz Max Sample Rate (PC dependent)

Powered from RS-232 Port

Datalogging Capability

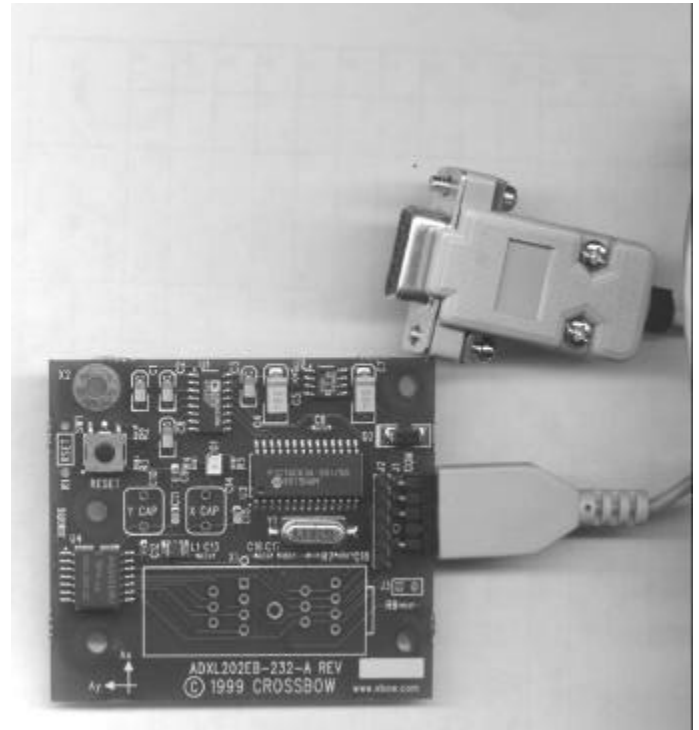
IC socket location for verifying ADXL202  
devices

### GENERAL DESCRIPTION

The ADXL202EB-232A is an evaluation board for the ADXL202 dual axis, 2 g accelerometer. The board demonstrates the ADXL202 interface to a low cost microcontroller, the Microchip 16C63, and is configured to read the PWM signals from the ADXL202, process them and convert them to a serial protocol for communication to a PC RS-232 port. Software is provided to read the RS-232 port and display real time acceleration data. A data logging feature is also included, so that data can be stored for later evaluation by a spreadsheet or other tool.

The evaluation board is designed specifically to help the designer understand accelerometers and specifically how the ADXL202 may work in the application, without the need to design HW or SW.

The firmware for the Microchip microcontroller and recommended firmware for other microcontrollers is available for free on the Analog Devices Website, ([www.analog.com/imems/](http://www.analog.com/imems/)). This product is meant as an evaluation board. Therefore, you may find the board/software combination unsuitable for all applications, such as FFT vibration analysis or precise time histories. This is a limitation of the evaluation software, not the ADXL202 accelerometer.



### APPLICATIONS

- Development of New Applications
  - Computer Peripherals
  - Earthquake detectors
  - Alarms and motion detectors
  - Battery powered motion sensing
- 2 Axis tilt sensing with faster response than electrolytic, mercury or thermal sensors
- Datalogging
- Instrumentation

8/4/99, Rev. C

## DETAILED DESCRIPTION

The ADXL202EB-232A is a dual axis RS-232 output digital accelerometer. The ADXL202EB-232 consists of the ADXL202JQC and the Microchip 16C63 microcontroller. The ADXL202 digital outputs are read using the timer / counter port of the microcontroller. The signals are converted from high and low times to a duty cycle in %. The X and Y duty cycle values are sent when requested. The board is powered by an extra control signal, RTS, on the RS-232 port. The voltage regulator is the low power ADM666.

### J1 Primary Connector, Serial Port Cable Plugs into J1

- 1 Power In - 6-12 Vdc unregulated, connected to RTS line of serial port
- 2 Transmit Data / RS-232 Out
- 3 Receive Data / RS-232 In
- 4 No Connect (Key)
- 5 Ground

### J2 Secondary Connector, Analog and PWM signals

- 1 Power In - 6 - 12 Vdc
- 2 XFILT
- 3 YFILT
- 4 XOUT
- 5 YOUT
- 6 Ground

### J3 ADXL202 Self Test (short pins 1 & 2 to activate the selftest mode)

- 1 SelfTest Input
- 2 Vcc

## SOFTWARE INSTALLATION

The product works on any Win3.1, Win95, Win98 or NT computer. The software is contained in a self-extractable zip file. Installation instructions are provided in a read-me file on the included CD ROM. Note that the software is also available on the Analog Devices website at [www.analog.com/imems/](http://www.analog.com/imems/).

## HARDWARE INSTALLATION

Connect the RS-232 cable to an available RS-232 COM port on your PC. Connect the demo board to the cable via the connector. The notch on the connector is pin 1 and should plug into J1. The cable is keyed to prevent the user from plugging it into the demo board incorrectly.

## Demo Board LED

The LED on the demo board should blink 5 times when it is connected to the serial communication port. This indicates that the demo board has power-up, passed the initialization routines and is ready to begin communication with the host software. If this doesn't happen press the reset button. If there is still a problem please see the troubleshooting section.

## Software SET UP

### Running X-Analyze.

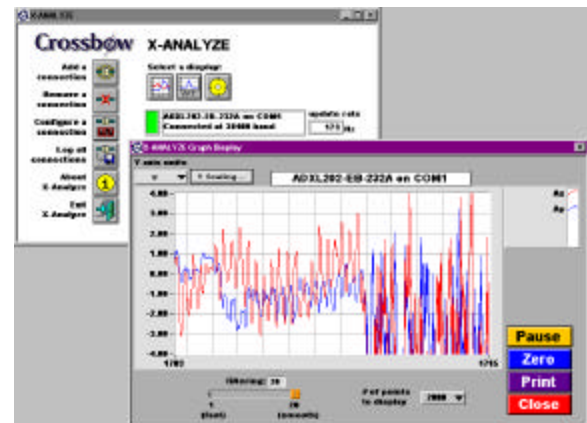
- 1.) Double clicking on the file name in the Explore window
- 2.) Select the program from the start menu
- 2.) Select Run... from the start menu and type or select the program.

### Add a Connection

To start, click on add a connection. If this is the first time you will only see "New connection". Click on Select. Select a com port and the ADXL202EB-232A. Click Select.

If this is not the first time, then you will see a list of previously defined connections. Choose the one that has the correct com port and the ADXL202EB-232A.

If everything is ok, you will see a green LED appear with the phrase "ADXL202-232A connect on COMx. Connected at 38400 baud". Where 'x' is the number of the serial communication port that was defined.



## GRAPHS.

Click on one of the following icons; Line/Chart, FFT, or Spirit Level to display the corresponding graph.

### Line Chart

The Line chart will show you the output of the X and Y accelerometers in either % duty cycle or acceleration in G's. Using the drop down edit box can change the amount of data that appears on the graph. The amount of averaging can be changed with the slide bar. The graph can be paused using the pause/resume button on the lower right hand side of the dialog box. The accelerometer can be zeroed by pressing the zero button. This allows relative measures to be performed.

### FFT

The displayed parameter can either be the X or Y acceleration in G.'s. The top trace is in the time domain and the bottom graph is the frequency response. The number of points to perform the FFT on can be selected on the left side of the dialog box.

### Spirit Level

The demo board can also be used as a tilt sensor that this display demonstrates. The Roll axis is defined to be the Ax axis and the Pitch axis is the Ay axis. Holding the left mouse button while over the knob will set the display range or by clicking on the number and entering a value. For best results the demo board should be calibrated prior to use.

## CALIBRATION

Clicking on "Configure a Connection" allows the user to modify the sensitivity and/or the 0-g value. To automatically calibrate the sensitivity and the 0-g value click on the "Calibrate" button. The software calculates the sensitivity by the formula  $(\text{Maximum} - \text{Minimum})/2$  where the Maximum and Minimum are the maximum and minimum values seen per axis as the demo board is rotated around. The 0-g value is calculated by taking the average value of the Maximum and Minimum values seen,  $(\text{Maximum} + \text{Minimum})/2$ . Care should be taken in rotating the demo board in a smooth fashion. For best results the demo board should be calibrated before each use.

### Sampling Rate

The sampling rate is the rate of which the demo board is sending data. To set the sampling rate click on "Configure a connection". One can either set the

maximum sample rate or a fixed sample rate. The fixed sample rate must be at a rate the host computer can sustain. To get the highest sampling rate, make sure that the X-Analyze software is the only program running and all other unnecessary programs has been closed. Because of limitations in the X-Analyze software and the Windows O.S. fixed rate sampling can typically only be done at less than 60% of maximum sample rate if the Update Rate is set to "as fast as possible."

### Data Logging

To save the values to a file click on the "Log all Connections" button. To stop data logging click on "Stop Logging" button. Note the button will toggle between "Log all connections" and "Stop Logging" depending if data logging is active or not. Open the Configure a connection window to specify the file name, location and logging rate. If constant sampling is required, the best approach would be to save the samples to a file and then perform post processing. Also close any unused programs and eliminate any screen or mouse activity. To get the best constant rate, set the datalogging rate and the update rate to the same value. Note: On occasion, missing samples might be noticed, this is a limitation in the X-Analyze software and Windows O.S. There has been much work to reduce, but not completely eliminate the problem.

### Averaging

Software averaging improves the noise rejection, however it reduces how quickly the accelerometer can respond to changes. Adjust the setting to the application requirements. The default setting is 5 averages.

## COMMUNICATIONS PROTOCOLS

The default RS-232 parameters are 38400 baud, 8 data bits, 1 start bit, no stop bits. The RS-232 protocol consists of a single ASCII command 'G' which returns a 4 byte data packet. The data packet consists of 2 bytes each of X-axis and Y-axis duty cycle data. See Tables 1,2, and 3.

**Table 1: Data Commands**

ASCII	Decimal/(Hex)	Description
G	71/(0x47)	Request data

**Table 2: Packet Structure**

Byte Number	Value	Description
1	0-255	X Axis MSB
2	0-255	X Axis LSB
3	0-255	Y Axis MSB

**Table 3: Data Encoding**

$$\text{PWM \%} = (256 * \text{MSB} + \text{LSB}) / 100.0$$

**COMPONENTS**

The demo board consists of an ADXL202 accelerometer, a 16C63 Microchip microcontroller, an ADM666 for voltage regulation of the RS-232 RTS signal, an ADM232 for RS232 interface, and a crystal. Note that many of these components are required only to support the RS-232 interface. In a stand-alone, (non-232) board, often only the ADXL202 and the Microchip controller will be necessary.

**RSET Resistor**

To change the PWM frequency, the resistor labeled R6 can be changed. Also there is a through-hole resistor location RSET. Note: since R6 and RSET are in parallel, one should only place a resistor in only one of the locations. Please consult the Analog Devices ADXL202 datasheet for values. The default value of R6 sets the PWM frequency to 2.0KHz

**X CAP/Y CAP Capacitors**

The analog filtering for the X and Y accelerometers are set by C15 and C11 respectively. There are through-hole capacitors locations labeled X CAP and Y CAP. Note: Since the pairs C15, X CAP and C11, Y CAP are in parallel, one should only place capacitors in one of the paired locations. Please consult the Analog Devices ADXL202 datasheet for more specifics. The default values of C15 and C11

set the analog cut-off frequency to 106Hz for both the X and Y accelerometers.

**Troubleshooting**

The ADXL202EB-232A is powered through your computer's COM port using the DTS line. Some computers do not supply enough power to the board. Other computers require that the serial port is active before the DTS line is forced high. If you do not see the red LED flash on the board when you first plug it into the serial port, this is most likely the problem. To activate the com port, attempt to connect to the com port through the software. After the connection fails, press the reset button on the demo board, then attempt to reconnect. If all else fails, try the board on another computer.

If you do not get the "connected" button to turn green on the evaluation software check the following things:

- The correct COM port is selected. Try switching the COM port setting on the software to make sure.
- Press the Reset Button. Verify that the LED on the demo board flashes.

Cannot get a consistent constant sampling rate:

- Close all other programs.
  - Datalog to a file and then do post-processing.
  - Set the datalog rate the same as the update rate.
- Spirit Level display is showing NaN or showing inconsistent results.
- Calibrate the demo board before using the Spirit Level display

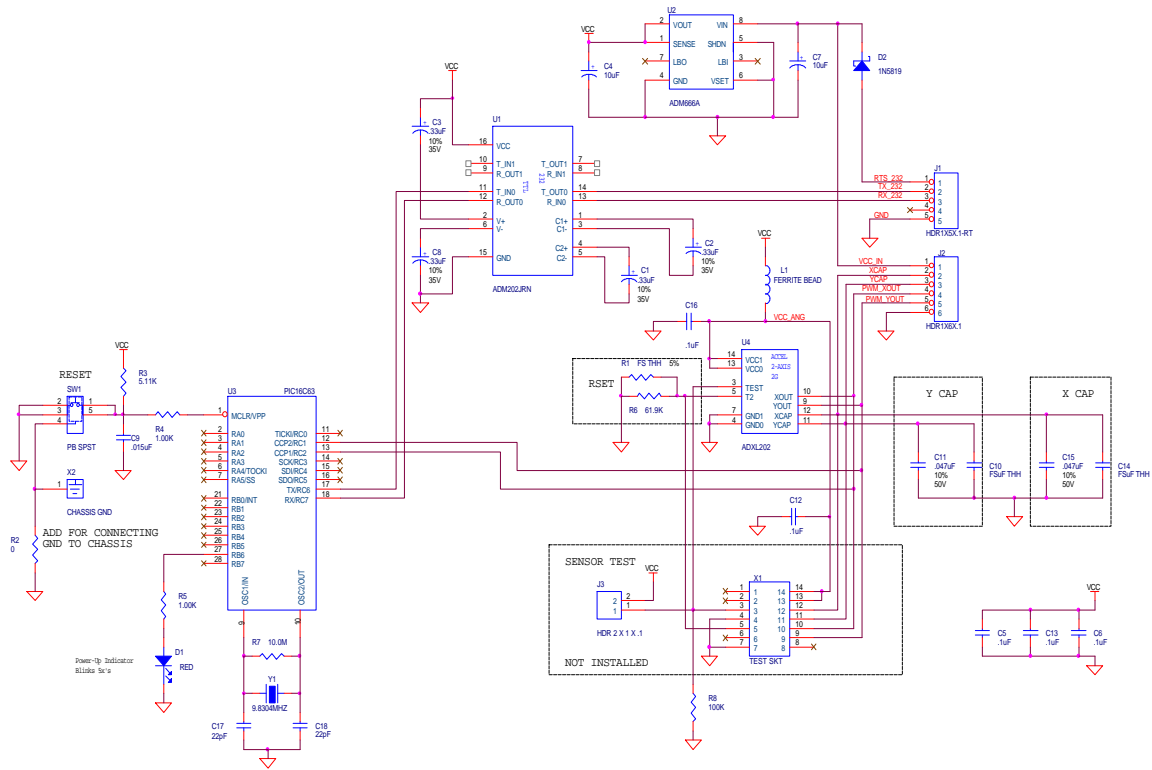


Figure 1 schematic of ADXL202EB-232A demo board