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*i*MEMS ADXL345/ADXL346 Inertial Sensor Datalogger and Development Board

FEATURES

Ultralow power ADXL345/ADXL346 accelerometer
Inertial sensor development board
Datalogs onto MicroSD card
Fully programmable via serial interface; firmware examples provided
Battery-powered for portable applications

REQUIREMENTS

2 AAA batteries
MicroSD card and card reader (for datalogging)
Computer with serial port (for programming)

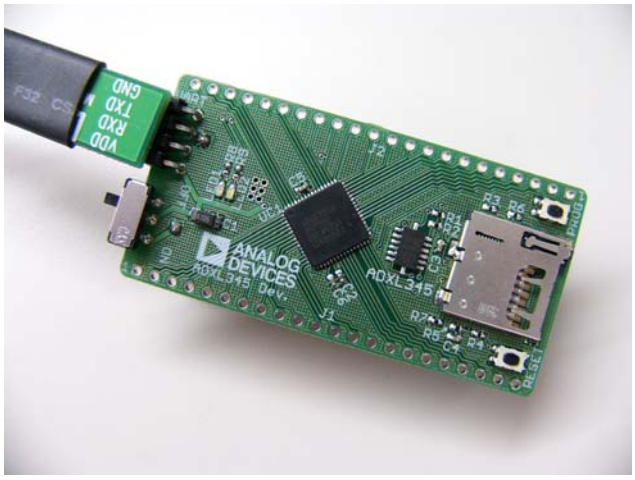

Figure 1. ADXL345 Inertial Sensor Development Board

GENERAL DESCRIPTION

It is often a timesaver in hardware development to make progress on the firmware and the hardware simultaneously. The challenge is that it proves difficult to develop firmware before the hardware exists. The *i*MEMS® ADXL345/ADXL346 development board is an easy-to-use tool that facilitates prototyping by providing a platform that can be duplicated in the final application. Additionally, the development board can be configured as a datalogger and can be used to gather data for refining algorithms, tuning thresholds, and generally familiarizing oneself with accelerometer data.

Two AAA batteries power the development board, and thus it integrates seamlessly into portable applications. Communications and processing are done by an ARM7-based ADuC7024 microcontroller, and the interface provided is fully reprogrammable. Moreover, all ADuC7024 pins are broken out into headers to facilitate design of compatible expansion boards. Data is logged onto a MicroSD memory card, providing essentially unlimited memory capacity and operating system versatility. Data is stored in a text file; therefore, there is no need to install any software to operate the board or read data. Software is provided to assist with programming the board.

TABLE OF CONTENTS

REVISION HISTORY

3/11—Rev. 0 to Rev. A

Added ADXL346 Throughout ..... Universal
Changes to Firmware Section 3
Changes to Figure 7 8
Changes to Figure 8 9
Added Appendix 10

6/10—Revision 0: Initial Version

OVERVIEW

The ADXL345/ADXL346 inertial sensor development board has the following features:

- A 2-layer printed circuit board (PCB), 1.20 inches × 2.30 inches form factor
- A two AAA battery power supply
- A 4-pin UART header to connect to an RS-232 interface cable
- Reset/download push buttons
- Power indicator/general-purpose LEDs
- Access to microcontroller I/Os from the external header
- Demonstration firmware logs 100 Hz acceleration data

FEATURES

Power Supply

A pair of AAA batteries powers the board, and the battery holder is located on the back of the board. An on/off switch on the lower left of the front of the board controls power to it. The battery voltage is not regulated but is decoupled with a 10 µF capacitor globally and an additional 1 µF capacitor at the device supply pins to ground.

RS-232 Interface

The ADuC7024 (UC1) P1.1 and P1.0 lines are connected to the RS-232 interface cable via the connector (UART). The interface cable generates the required level shifting to allow direct connection to a PC serial port. Ensure that the supplied cable is connected to the board correctly; that is, VDD is connected to VDD and GND is connected to GND.

RESET/PROG Push Buttons

A **RESET** push button is provided to allow the user to manually reset the part. When the **RESET** button is inserted, the $\overline{\text{RST}}$ pin of the ADuC7024 is pulled to GND. Because the $\overline{\text{RST}}$ pin is Schmitt-triggered internally, there is no need to use an external Schmitt trigger on this pin.

To enter serial download mode, the user must hold the P0.0/BM pin low while reset is toggled. On the development board, serial download mode can be easily initiated by holding down the serial download push button (PROG) while inserting and releasing the reset button (RESET), as illustrated in Figure 2.

Power Indicator/General-Purpose LEDs

Two general-purpose LEDs are available on the board. A red LED (LED1) is connected to P4.5 of the ADuC7024, and a green LED (LED2) is connected to P4.4. Both LEDs can be repurposed via firmware.

Breakout Header

Many of the ADuC7024 pins are connected to headers on either side of the board. The headers come unpopulated but can be populated using standard 0.1 inch header pins.

The thin form factor of the top of the board allows the design of an expansion board to connect above the development board, with the header pins providing both electrical and physical connections.

Firmware

Sample firmware is provided on the ADXL345 product page under the **Development Board** heading. The **Firmware** link downloads a Keil project that implements the 100 Hz datalogging firmware. This project can be modified as needed.

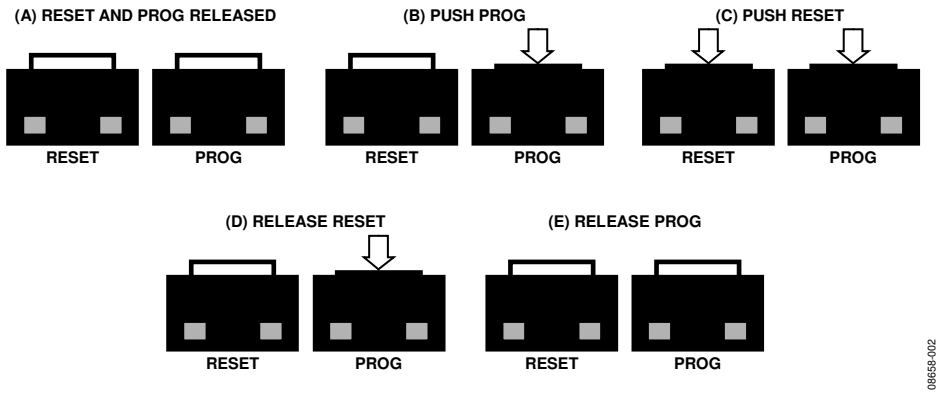

Figure 2. Entering Serial Download Mode to Reprogram the Board

USING THE BOARD

GETTING STARTED

The development board comes preprogrammed as a datalogger at a 100 Hz datarate. To log data, do the following:

1. Insert two AAA batteries into the battery holder.
2. Insert the MicroSD card into the slot. The card should be formatted with a FAT32 file system; most MicroSD cards come this way.
3. Push the on/off switch to the on position to power up the board. The red LED turns on, and the green LED blinks to indicate that the board is logging data.
4. When logging is completed, slide the on/off switch to the off position.
5. Remove the card from the slot and insert it into the card reader.
6. Insert the card reader into the USB port on your computer.

The acceleration log file is written to the path \XL345\DATA0000.TXT on the MicroSD card. The data in the text file consists of a set of comma-separated t, x, y, and z values, where t corresponds to time and x, y, and z correspond to the x-, y-, and z-axis acceleration data for each time point. Refer to the Appendix: Sample Output File for an example of a data file. Acceleration values are logged in LSB, where the nominal scale factor is 3.9 mg/LSB. To convert an acceleration value from LSB to mg, simply multiply by 3.9 (nominally, or measure the sensitivity of the part for a more accurate conversion).

To plot the logged data using Microsoft® Excel, download the **Plotting Tool** (XL345DB_DataPlotter.xls) from the ADXL345 product page (under the **Development Board** heading) and follow the instructions described in the file. Users are prompted to browse to their logged data file (DATA0000.TXT), the data is imported and plotted in a new workbook, and users are then prompted to save that workbook.

PROGRAMMING THE BOARD

The board can be repurposed with no programming required using the .hex files provided on the ADXL345 product page. The .hex files are uploaded onto the board using the ARMWSD program, which can be downloaded at www.analog.com/static/imported-files/eval_boards/ARMWSDv1.8.zip. Simply unzip the folder to a known location and open the ARMWSD.exe file to use the program. No installation is required.

To reprogram the board, use the cable provided with the board and follow these instructions:

1. Download the desired .hex file from the ADXL345 product page to a known location, or locate it on your machine.
2. Open ARMWSD.
3. Click **Configure…** (see Figure 3) and select the **Parts** tab, shown in Figure 4. Make sure the **ADuC7024** is selected in the **Select Part** pull-down list (see Figure 4). Additionally, in the **Comms** tab, make sure the **Baudrate** is set to 115200, and the **Serial Port** is set to COM1, and then click **OK**.
4. In the ARMWSD window, click **Browse…** (see encircled in Figure 3) and navigate to the location of the .hex file to be loaded onto the board. Select the file and click **Open**.

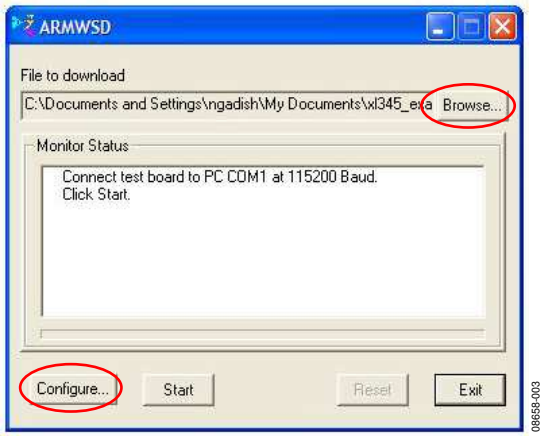

Figure 3. ARMWSD Window

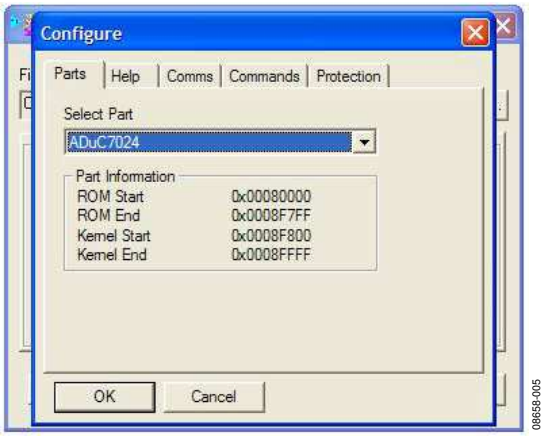

Figure 4. ARMWSD Configure Window: Parts Tab

5. Connect the programming cable to the serial port on the PC and to the 4-pin header near the on/off switch on the board, matching up the corresponding pins.
6. In the ARMWSD window, click **Start**. The Status frame then prompts users to **Press Download and pulse Reset on Hardware**. Follow the illustrations in Figure 2.
7. When download is complete, click the **Reset** button on the evaluation board. Users can now close the ARMWSD program.

SOFTWARE TOOLS

In addition to the ready-to-upload examples provided in the **Firmware** link of the **Development Board** section of the ADXL345 product page, the development board is fully modifiable and reprogrammable to allow for easy prototyping and firmware development. Firmware is written in C, and it is compiled for the ADuC7024 ARM7 processor.

The firmware examples provided on the ADXL345 product page were written using Keil Microvision and compiled using the RealView compiler. A free evaluation version of Keil Microvision is available online. Additional software suites (Keil, IAR, and GNU) for writing and compiling code are available.

For instructions on how to install and use the software, refer to the *ADuC702x MicroConverter™ GetStarted Guide*.

To reprogram the board, download the ARMWSD program from the **Uploader** link in the **Development Board** section of the ADXL345 product page.

When Keil Microvision is installed, complete the following steps:

1. Click and download the **Sample Project** (**EVAL-ADXL345Z-DB Files.zip**) file from the **ADXL345 Development Board** section of the ADXL345 product page.
2. Unzip the **EVAL-ADXL345Z-DB Files.zip** file into a known directory.
3. Navigate into the **EVAL-ADXL345Z-DB** folder and open **datalogger.uvproj**. This Keil Microvision project allows users to modify and recompile the program.

EVALUATION BOARD SCHEMATIC AND LAYOUT

See the appropriate product pages for electronic versions of the layout and schematic files.

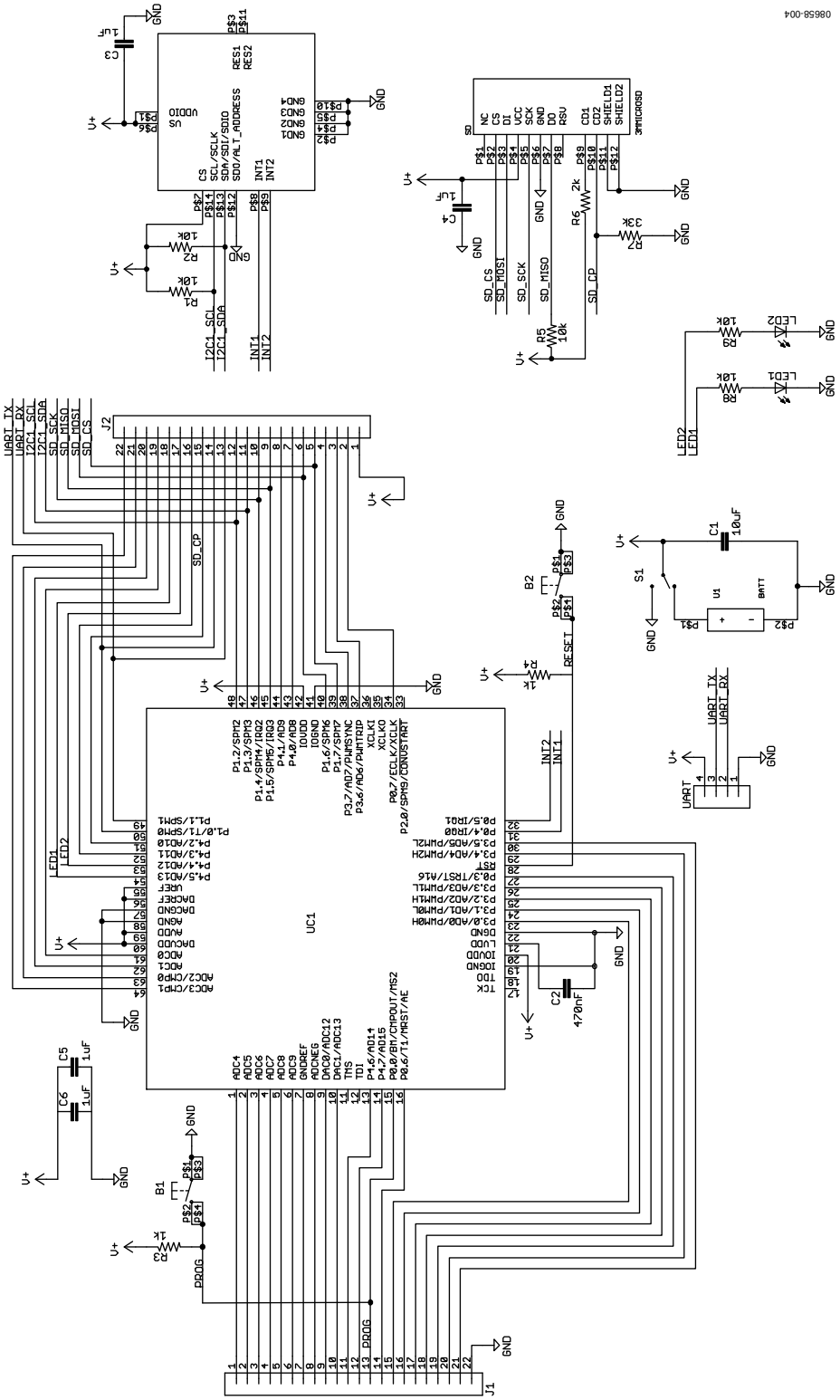

Figure 5. ADXL345 Development Board Schematic

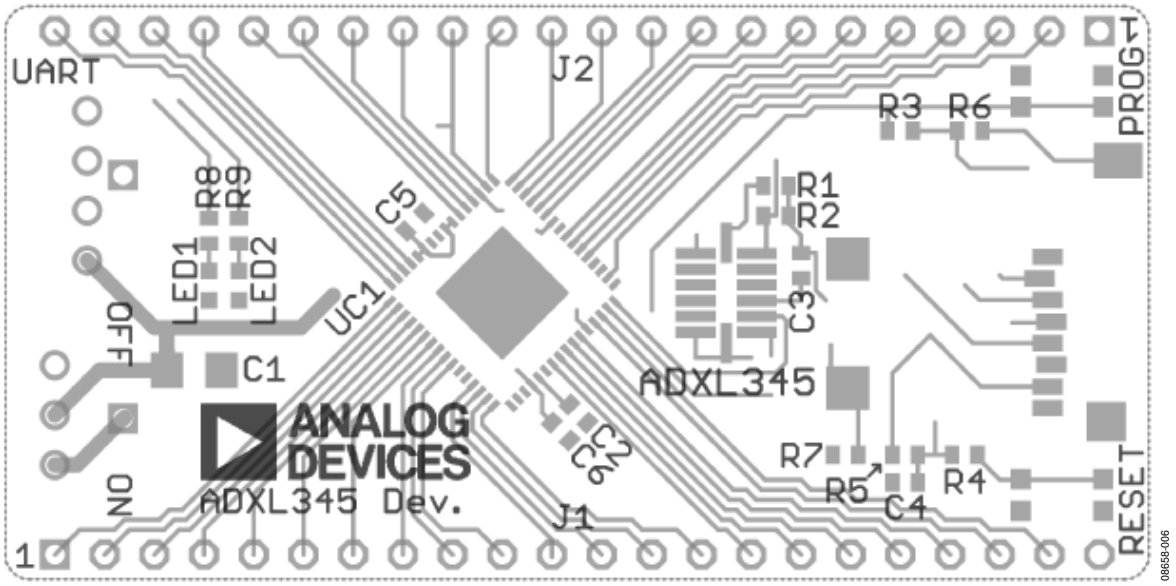

Figure 6. ADXL345 Development Board Layout

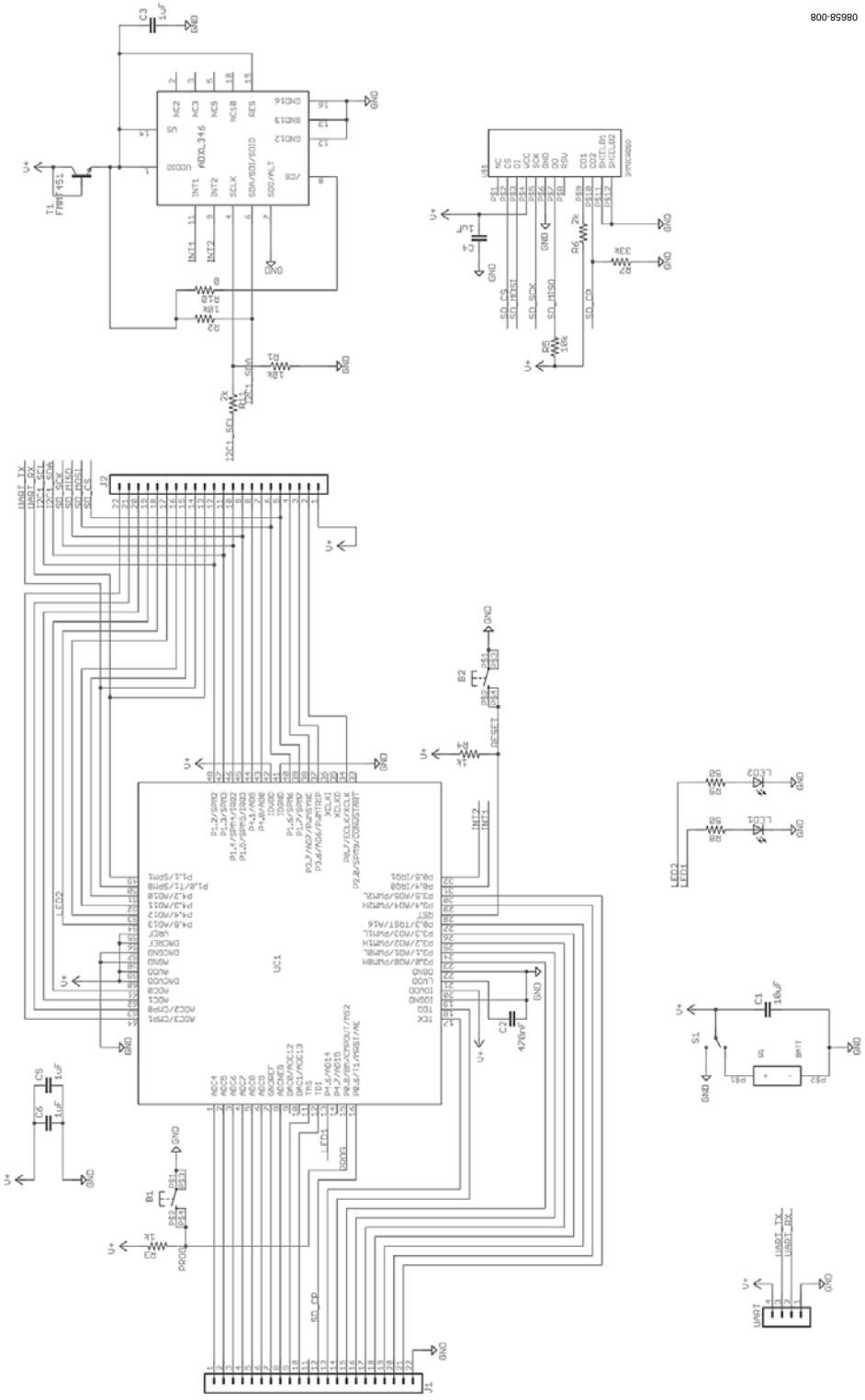

Figure 7. ADXL346 Development Board Schematic

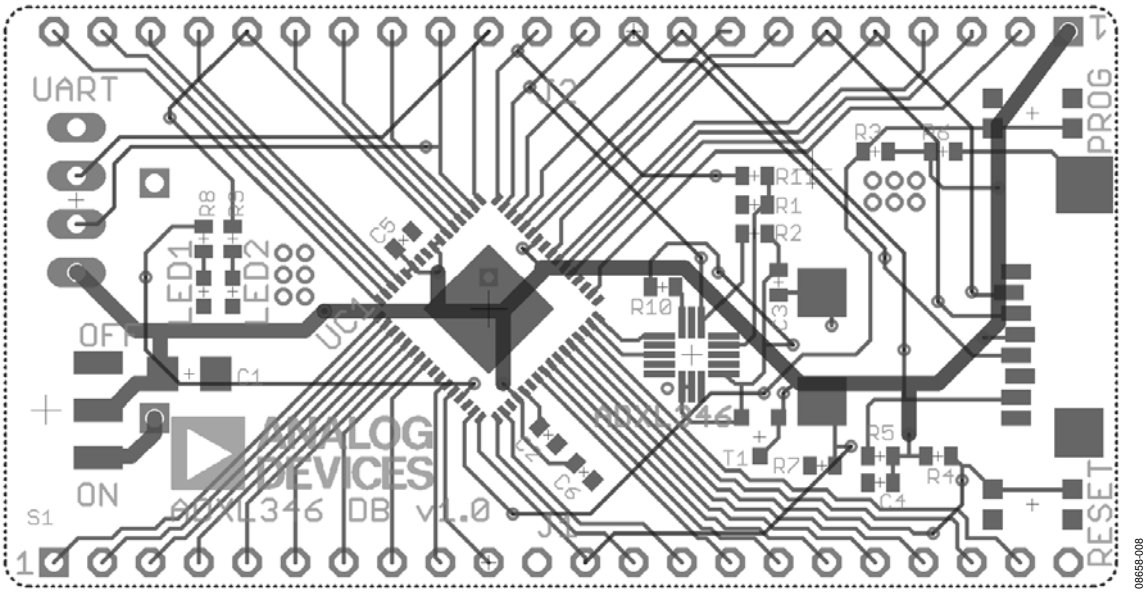

Figure 8. ADXL346 Development Board Layout

APPENDIX: SAMPLE OUTPUT FILE

```
t,x,y,z
0,60,20,247
50,60,19,259
100,57,17,258
151,58,18,260
201,61,14,252
252,58,10,252
302,63,21,248
353,66,23,255
403,67,21,243
454,53,35,254
504,63,32,251
555,63,31,241
605,65,33,256
656,59,34,254
706,60,34,247
757,55,41,250
807,56,41,252
858,58,43,245
908,60,40,246
959,60,38,246
1009,66,37,249
1060,64,29,252
1110,69,36,251
1161,68,31,253
1211,66,47,233
1262,63,40,246
1312,59,36,246
1363,48,41,244
1413,49,41,248
1464,46,51,252
1514,52,39,264
1565,47,42,260
1576,47,43,254
1585,25,-5,263
1595,26,-2,263
1605,26,-5,257
1615,26,-4,257
1625,28,-3,258
1634,28,-1,261
1644,24,-2,263
1654,24,1,263
1664,25,0,261
1674,27,0,263
1683,24,-2,263
1693,22,-1,265
1703,23,-2,264
1713,22,0,265
1723,22,0,260
1732,22,-1,261
1742,23,0,258
1752,23,-1,259
1762,25,-1,256
1772,26,-1,256
1781,21,-2,257
1791,21,-4,256
1801,20,-4,259
1811,21,-2,260
1821,19,-5,260
1830,17,-4,258
1840,18,-3,260
1850,20,-5,260
1860,20,-2,260
1870,20,-2,261
1870,20,-2,264
1880,25,2,264
1890,23,2,262
1901,25,-1,260
1911,24,0,264
1922,27,1,263
1932,30,0,265
1942,30,2,265
1953,27,2,263
1963,28,1,263
1974,27,1,264
1984,29,0,261
1994,29,0,263
2005,27,0,261
2015,26,0,259
2026,28,-1,257
2036,26,-3,257
2046,27,-2,259
2057,23,-1,262
2067,24,-3,261
```

NOTES

NOTES

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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