ANALOG DEVICES

Evaluation Board for SPI®-/I²C®-Compatible, 10-Bit Digital Temperature Sensor and Quad DAC

EVAL-ADT7316EB

ADT7316 FEATURES

ADT7316: Four 12-bit DACs
ADT7317: Four 10-bit DACs
ADT7318: Four 8-bit DACs
Buffered voltage output
Guaranteed monotonic by design over all codes
10-bit temperature-to-digital converter
Temperature range: −40°C to +120°C
Temperature sensor accuracy of ±0.5°C
Supply range: 2.7 V to 5.5 V
DAC output range: 0 V to 2 V$_{REF}$
Power-down current: 1 µA
Internal 2.28 V$_{REF}$ option
Double-buffered input logic
Buffered/unbuffered reference input option
Power-on reset to 0 V
Simultaneous update of outputs (LDAC function)
On-chip rail-to-rail output buffer amplifier
I²C®-, SMBus-, SPI®-, QSPI™-, MICROWIRE™-, and DSP-compatible, 4-wire serial interface
SMBus packet error checking (PEC) compatible
16-lead QSOP package

ADT7316 APPLICATIONS

Portable battery-powered instruments
Personal computers
Telecommunications systems
Electronic test equipment
Domestic appliances
Process control

PRODUCT DESCRIPTION

The ADT7316 evaluation board allows the ADT7316 digital temperature sensor and quad DAC to be quickly and easily evaluated using a personal computer. Using the evaluation board and its accompanying software, the ADT7316 evaluation board can be interfaced to any personal computer running Microsoft® Windows® XP/2000 or later, via one of the computer's USB ports.

The two other parts in the family, the ADT7317 and ADT7318, differ only in that they have 10-bit DACs and 8-bit DACs respectively. The evaluation board can be used to emulate the ADT7317 by setting the two LSBs of the DACs to zero, and for the ADT7318 by setting the four LSBs of the DACs to zero.

The evaluation board allows all the input and output functions of the ADT7316 to be exercised without the need for external components. The software allows control and monitoring of the internal registers for the ADT7316.

PACKAGE CONTENTS

The evaluation board package contains the following items:

- This document
- The ADT7316 evaluation board
- Evaluation software on CD-ROM
- USB cable

Note: Devices with date codes earlier than 0529 have an internal reference voltage of 2.25 V.
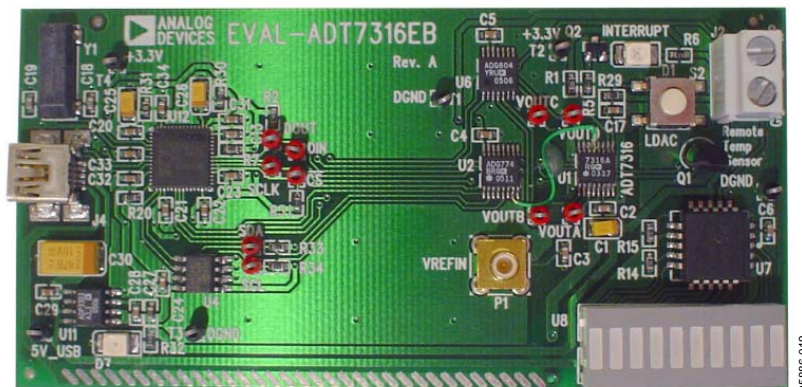
DIGITAL PICTURE

Figure 1.

TABLE OF CONTENTS

REVISION HISTORY

1/06—Rev. 0 to Rev. A

Revision 0: Initial Version

PARTS DESCRIPTION

This section gives a brief description of the ADT7316/ADT7317/ADT7318 and the system overview. Further information can be found in the ADT7316/ADT7317/ADT7318 data sheet located at www.analog.com.

The ADT7316/ADT7317/ADT7318 combine a 10-bit temperature-to-digital converter and a quad 12-/10-/8-bit DAC, respectively, in a 16-lead QSOP. This includes a band gap temperature sensor and a 10-bit ADC to monitor and digitize the temperature reading to a resolution of 0.25°C.

The ADT7316/ADT7317/ADT7318 operate from a single 2.7 V to 5.5 V supply. The output voltage of the DAC ranges from 0 V to 2 V_{REF}, with an output voltage settling time of typically 7 ms. The ADT7316/ADT7317/ADT7318 provide two serial interface options, a 4-wire serial interface that is compatible with SPI, QSPI, MICROWIRE, and DSP interface standards, and a 2-wire SMBus/I²C interface. The devices feature a standby mode that is controlled via the serial interface.

EVALUATION BOARD HARDWARE

The ADT7316 evaluation board contains the following main components:

- ADT7316 IC, U1
- USB microcontroller, U12
- Analog switches
- Interrupt LED, D1
- Power LED, D7
- Temperature sensor, Q1
- Bargraph driver and LED bargraph, U7/U8
- Connector for USB interface, J4
- DAC output connector, J2
- V_{REF} input connector, P1
- LDAC push button, S2

USING THE HARDWARE

The hardware is extremely simple to use. Make sure the software is installed before connecting the evaluation board to a USB port on the PC using the USB A to Mini-B cable provided. No external power supply is required.

MINI-B USB CONNECTOR J4

The connections to J4 are shown in Table 1.

Table 1. J4 Connections

J4 Pin	Mini-B Function
1	+5 volts
2	−Data
3	+Data
4	Key (not used; connected to ground)
5	Ground

The USB microcontroller, U12, handles the rest of the communication between the Mini-B plug and the evaluation board.

DAC OUTPUT CONNECTOR J2

The output of any one of the four DACs (selected by the software) is available on this connector.

V_{REF} INPUT CONNECTOR P1

An external reference voltage from 0.25 V to V_{DD} can be connected to P1.

TEST POINTS

Various system logic signals and the individual DAC outputs are available at the test points on the board.

EVALUATION BOARD SOFTWARE

The software allows the functions of the ADT7316 to be controlled from a PC via an easy-to-use interface operating with Windows XP/2000 or higher. The contents of the device's internal registers can be read or altered through a user friendly interface, while the Visual Display window gives a graphical display of temperature and voltage and allows the overtemperature limit to be altered using a "slider" control.

INSTALLING THE SOFTWARE

Follow these steps to install the ADT7316 evaluation software.

1. Insert the CD-ROM into the CD-ROM drive.

2. Click **Start**, and then click **Run**.

3. Type **X:ADT7316Eval v2.0.2.exe** where "**X**" is the letter of your CD-ROM drive.

4. Click **OK**.

   Alternatively, you can run Windows Explorer or My Computer, select the CD-ROM drive, and then double-click the **ADT7316Eval v2.0.2.exe** file.

5. Extract the files needed to install the software and start the InstallShield Wizard as shown in Figure 2.
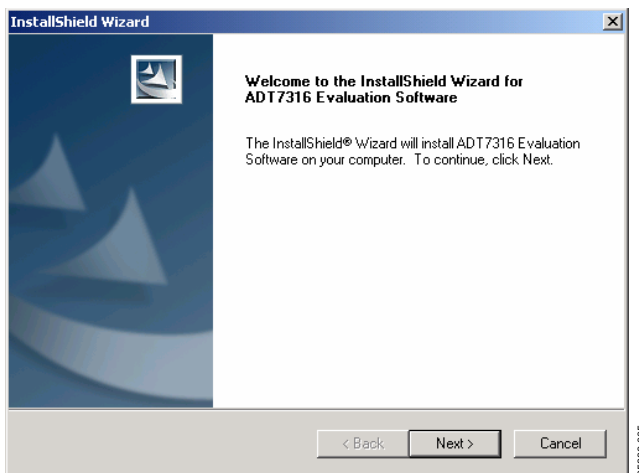

Figure 2. InstallShield Wizard Start-Up Screen

6. Click **Next** to continue the installation.
   Various installation options are available, depending on whether a version of the software is already installed. If this is a new installation, a license agreement appears. Click **Yes** to accept the agreement and continue with the installation. If there is an existing installation, refer to the Existing Software Installation section.

7. To install the software in the default folder shown, click **Next**. Otherwise, click **Browse** and choose a different folder; then, select the folder in which to install the program and click **OK**.

Typical, Compact, or Custom Installation

You are now given the option to choose a typical, compact, or custom installation of the software. Select the desired option, and then click **Next**.

If **Custom** is selected, a dialog box appears allowing individual components to be installed. Select and/or deselect any components you want or do not want to install, and then click **Next**.

If **Typical** or **Compact** installation is selected, the **Select Program Folder** dialog box appears. This allows you to select the program folder to which program icons are added. Select the desired folder and click **Next**.

InstallShield now installs the program files to the selected folders.

You must restart your computer to begin using the software. To restart your computer, click **Yes**. If you do not want to use the software immediately, click **No**.

Click **Finish** to complete the installation.

Existing Software Installation

If an existing version of the software is found during installation, you can modify the installation by adding or removing components, repair the installation by replacing existing files with ones from the CD-ROM (useful if a file has been corrupted), or uninstall the entire software package.

Select the desired option and click **Next**. If **Modify** is selected, you can add or remove components. If **Repair** is selected, all of the installed files are replaced with new files from the CD-ROM. If **Remove** is selected, you are prompted to confirm the complete removal of the software. Click **OK** to confirm removal of the software. During removal of the software, you may need to confirm removal of some files.

Caution: These files may be in use by other Analog Devices software. If no other Analog Devices software is installed on the system, it is safe to delete them. To remove all shared files without further prompting, select **Don't display this message again** and then click **Yes**.

Click **Finish** to complete the installation procedure.

USING THE SOFTWARE

When using the software, first ensure that the evaluation board is powered up and connected to the parallel printer port.

To start the software, click **Start** > **All Programs** > **Analog Devices** > **ADT7316 Evaluation Software** > **ADT7316 Evaluation Software**.

The software searches for the evaluation board and initializes it, as shown in Figure 3.

Figure 3. ADT7316 Found

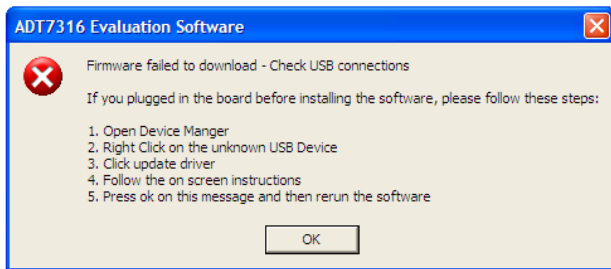If the evaluation board is not found, the following message appears.

Figure 4. ADT7316 Not Found

If this happens, check that the evaluation board is connected correctly, ensure that S1 is set in the correct position and D1 is lit, and then try again.

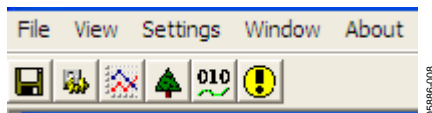At the top of the program window is a series of menus and icons.

Figure 5. Menu and Icon Bar

These can be used to access the various functions of the software.

Table 2. Icon Functions

Icon	Function
	Allows data to be logged and saved. You can also use the **File** menu to select this function.
	Sets up interrupts and limits. You can also use the **Device** menu to select this function.
	Displays a tree of the device registers. You can also use the **View** menu to select this function.
	Displays graphs of temperature and voltage. You can also use the **View** menu to select this function.
	Allows the device to be configured. You can also use the **Settings** menu to select this function.
	Allows the DAC outputs to be adjusted. You can also use the **Settings** menu to select this function.

Multiple windows for the previous software functions can be open and active simultaneously. The **Window** menu shows which window is on top and allows any window to be brought to the front.

Configuration

Click the **Configuration** icon to access the **Configuration** dialog box. This dialog box allows you to set up the AD7316. It consists of a set of four tabbed pages that allow various functions of the device to be configured.
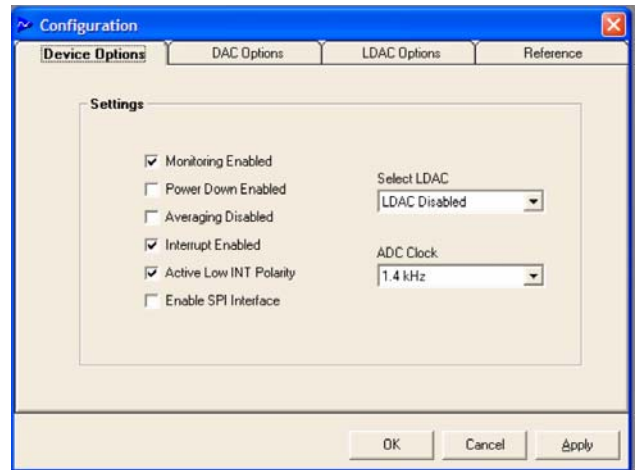

Figure 6. Device Options Tab

The **Device Options** tab allows you to select/clear the following options:

- Monitoring Enabled
- Power Down Enabled
- Averaging Disabled
- Interrupt Enabled
- Active Low INT Polarity
- Enable SPI Interface (Note that if SPI interface is enabled, to switch back to I^{2}C interface it is necessary to exit the software, disconnect the board, and start again.)
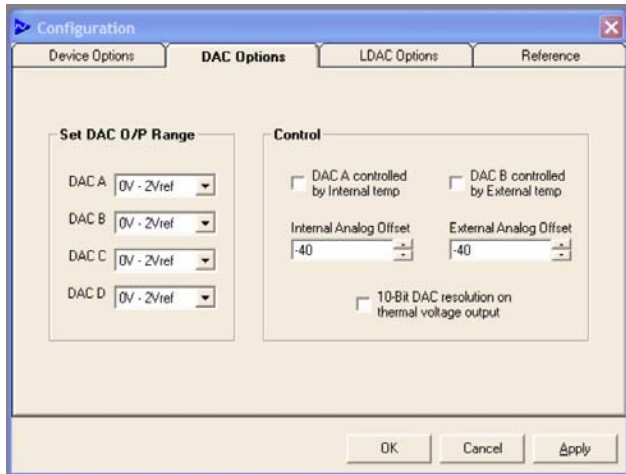- Select LDAC
- ADC Clock (1.4 kHz or 22.5 kHz)

Figure 7. DAC Options Tab

The **DAC Options** tab selects the output range for each DAC (0 V to V_{REF} or 0 V to 2 V_{REF}). It allows the thermal voltage function of the device to be configured, where the ADT7316 operates as a temperature-to-voltage converter, with DAC A controlled by the on-chip temperature sensor and DAC B controlled by the external temperature sensor. The temperature corresponding to 0 V output can be set by adjusting the analog offset for each channel, and the resolution for the thermal voltage function can be set to 8 bits or 10 bits.
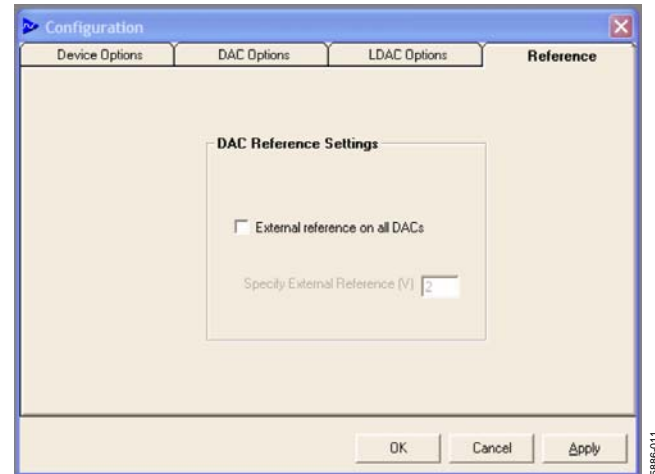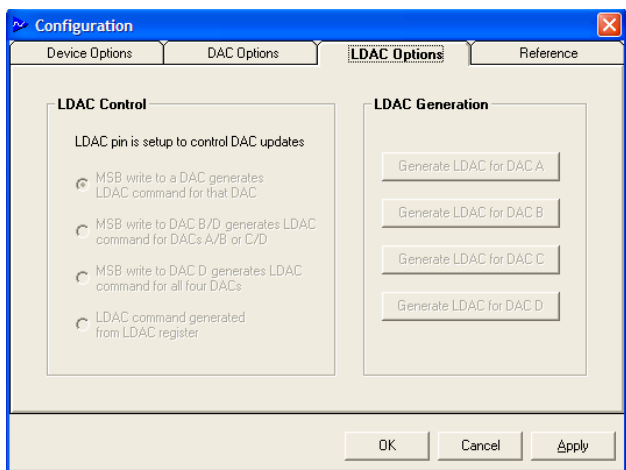

Figure 8. LDAC Options Tab

The **LDAC Options** tab selects how the DACs are updated. They can be updated manually from the LDAC pin by pressing S2, when the MSBs are written to one of the DACs (three different options available), or from the LDAC register. If the LDAC register is selected, the **LDAC Generation** buttons (located on the right side of the tab) are active. Click one of these buttons to update the corresponding DAC.
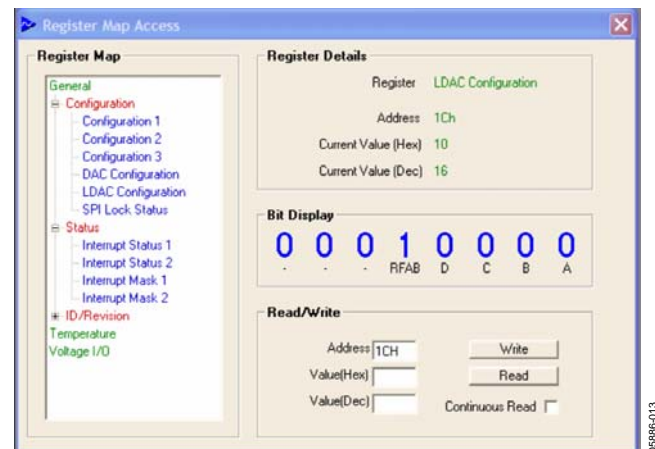

Figure 9. Reference Tab

The **Reference** tab features a check box that toggles the internal 2.28 V reference for all four DACs, or an external reference connected to P1. V_{REF} is limited by the V_{DD} of the ADT7316 so a value exceeding this (3.3 V) should not be applied to the V_{REF} Connector P1 (or a half of V_{DD} when 0 V to 2 V_{REF} is selected on the **DAC Options** tab). If an external reference voltage is used, its value should be specified in the box provided. This is to allow the DAC value to be scaled correctly.

Register Map Access

Click the 🌲 icon or use the **View** menu to select the **Register Map Access** dialog box.

Figure 10. Register Map Access Dialog Box

This dialog box allows the contents of individual registers to be viewed, and those registers that are read/write can have their contents changed. The **Register Map** tree on the left shows the registers arranged by function. To expand or contract a branch of the tree, double-click the green label. Double-click the red label or click the + symbol to expand the tree further. To select an individual register, click the blue label.

The name of the register, its address, and its contents in hexadecimal, decimal, and binary format are displayed. The register contents can be read by clicking **Read**, or set to continuous reading by selecting **Continuous Read**. Those registers that are read/write can have their contents changed by clicking individual bits of the binary display to toggle them, or by entering a decimal or hex value in the **Read/Write** section and clicking **Write**.

Graphing

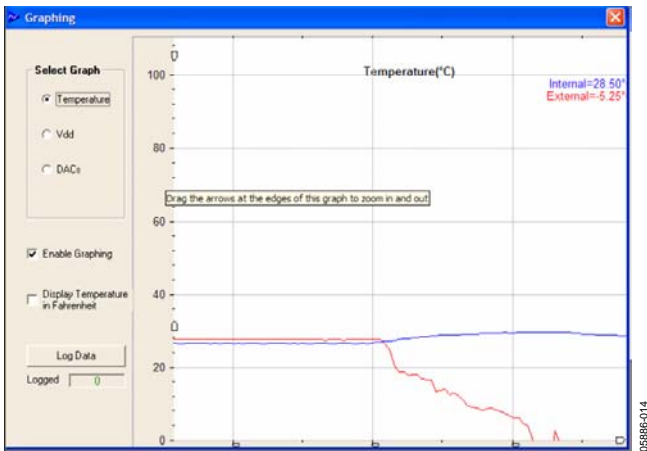Click the icon or use the **View** menu to access the **Graphing** dialog box.

Figure 11. Graphing Dialog Box

This dialog box allows the internal or external temperature, V_{DD}, or the DAC outputs, to be displayed as a rolling graph. Measurement limits can also be displayed. To view the graphic data in more or less detail, move the arrow pointers on the X-axis and Y-axis to zoom in or zoom out.

DAC Control

Click the icon or use the **Device** menu to access the **DAC Control** dialog box.
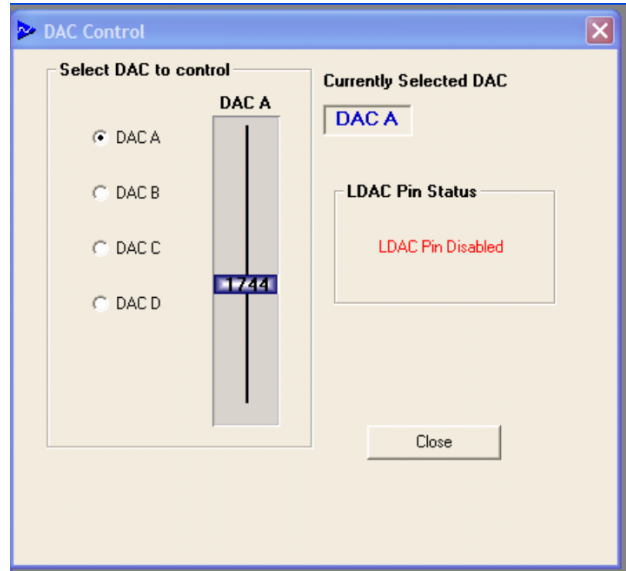

Figure 12. DAC Control Dialog Box

The **DAC Control** dialog box allows the individual DACs to be controlled manually without having to manipulate the DAC registers directly. A DAC can be selected and controlled using the slider.

Setting Interrupts and Limits

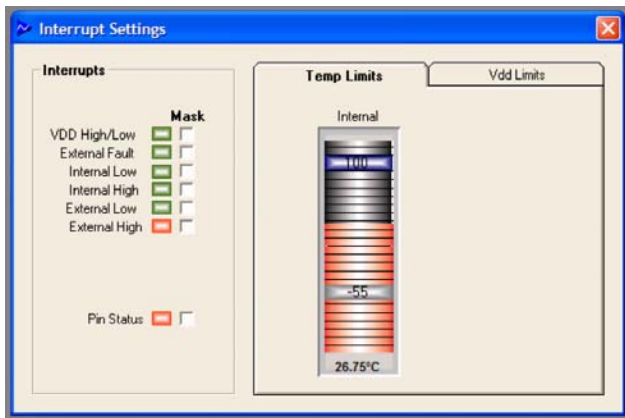Click the ⚠ icon or use the **Device** menu to access the **Interrupt Settings** dialog box.

Figure 13. Interrupt Settings Dialog Box

The six interrupt sources are shown on the left of the dialog box. When an interrupt is asserted, the corresponding green status indicator turns red. Interrupts can be masked by selecting the box next to the name of the interrupt source. High and low limits for the two measured parameters (internal temperature and V_{DD}) can be set using the slider controls.

Data Logging

Click the 💾 icon or use the **File** menu to access data logging.
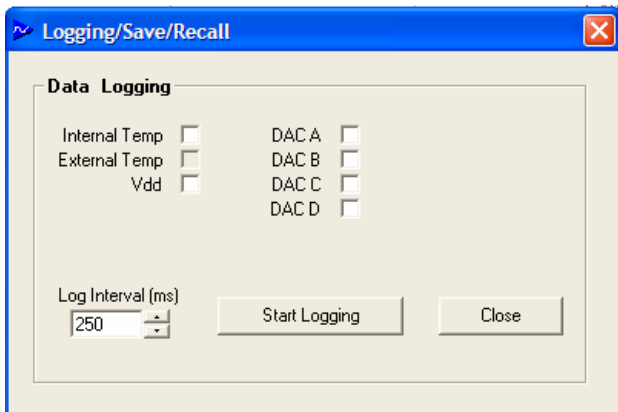
Figure 14. Logging/Save/Recall Dialog Box

This dialog box allows you to set which inputs are logged, as well as the log interval. Once this has been set up, click **Start Logging** and the **Open** dialog box appears.
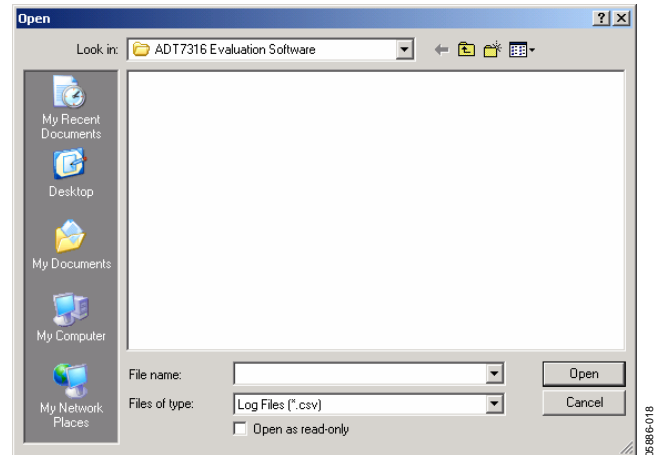
Figure 15. Open Dialog Box

You can use this dialog box to open an existing log file or create a new log file by typing in a new file name.

After selecting an existing file or typing a new file name, click **Open** to begin data logging. To stop data logging, click **Stop Logging**.

Note that graphing must be running during data logging, or the data does not change.

SCHEMATICS AND SILKSCREEN

Figure 16. Evaluation Board Schematic

Figure 17. ADT7316 Evaluation Board Schematic (Continued)

Figure 18. ADT7316 Evaluation Board Schematic (Continued)

Figure 19. ADT7316 Evaluation Board Silkscreen

ORDERING INFORMATION

BILL OF MATERIALS

Table 3. Parts List for EVAL-ADT7316EB Evaluation Board

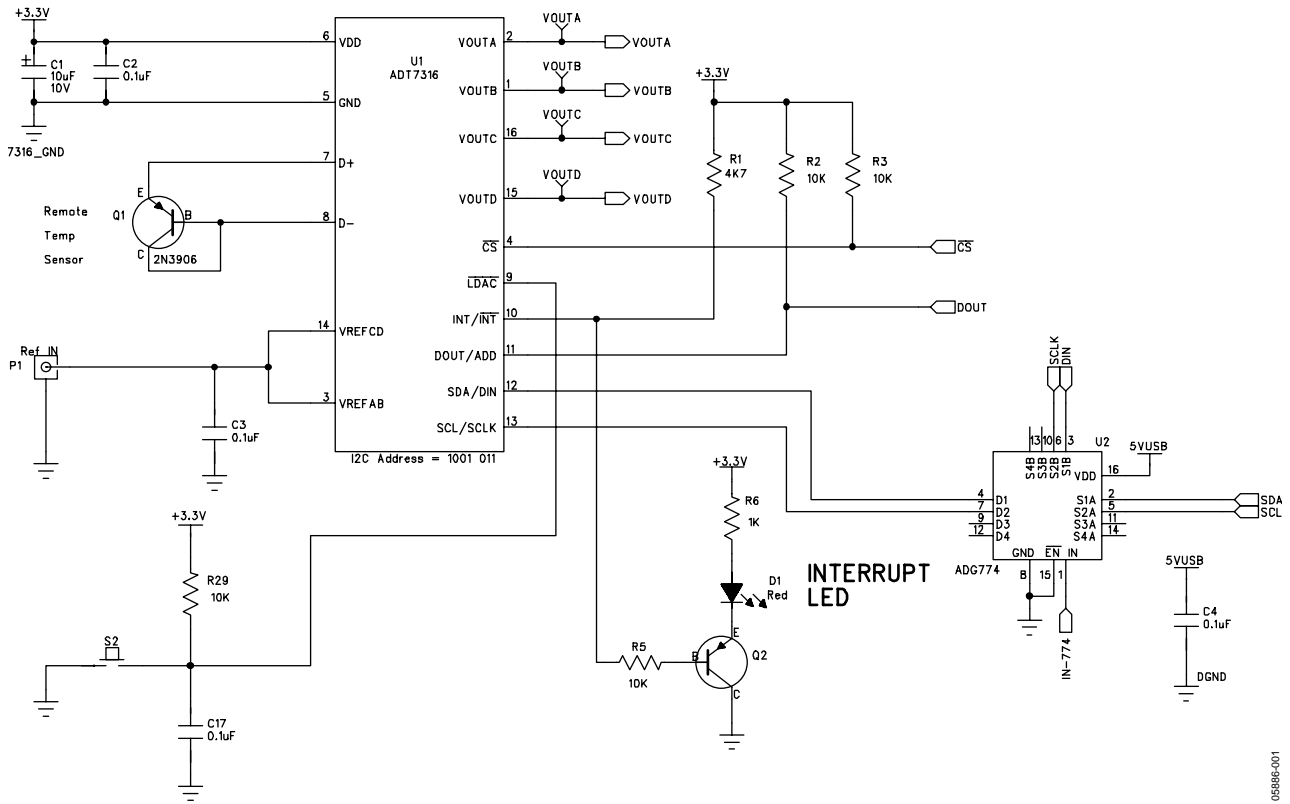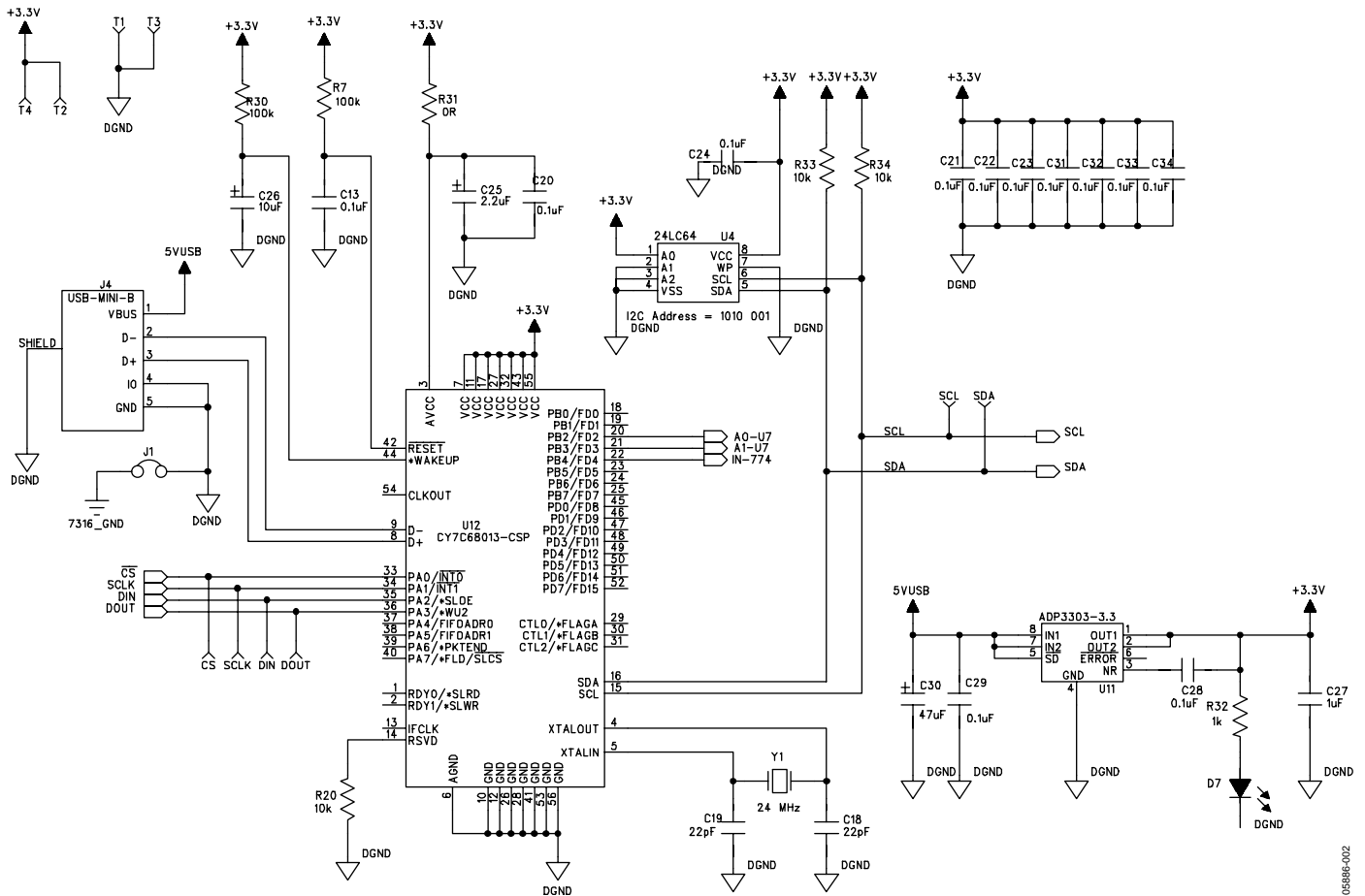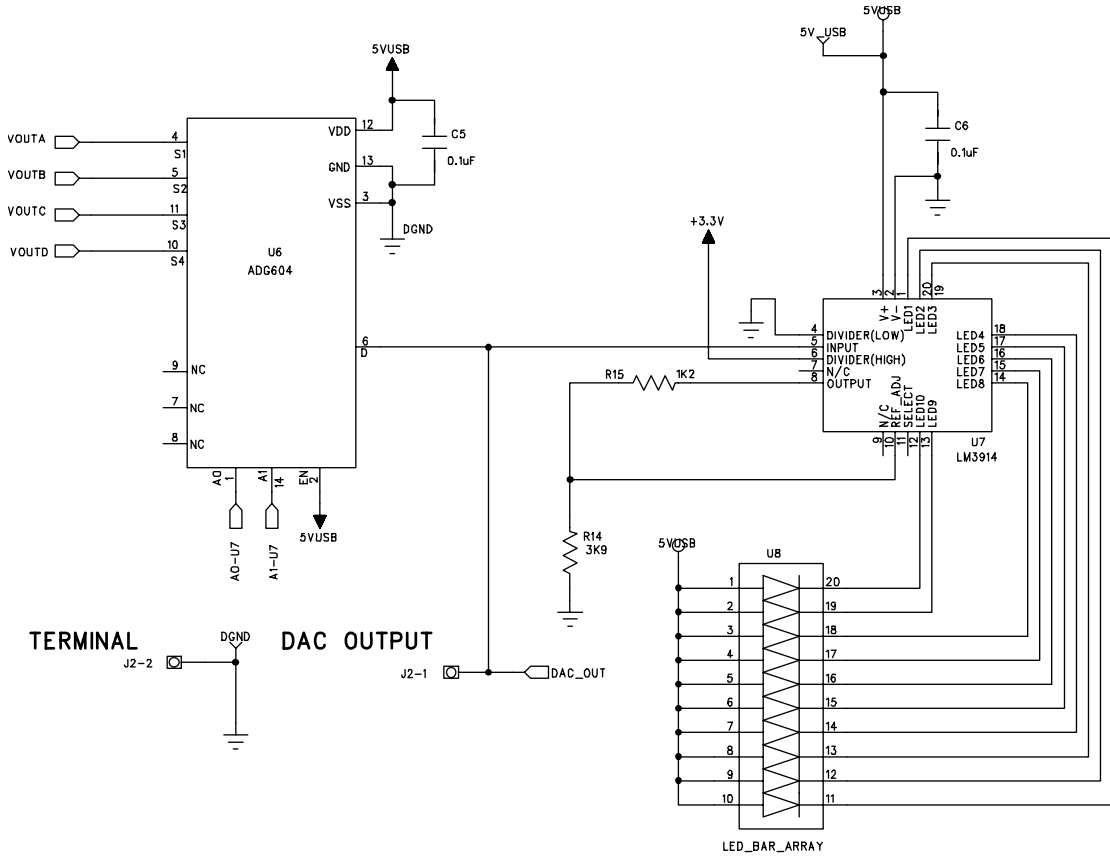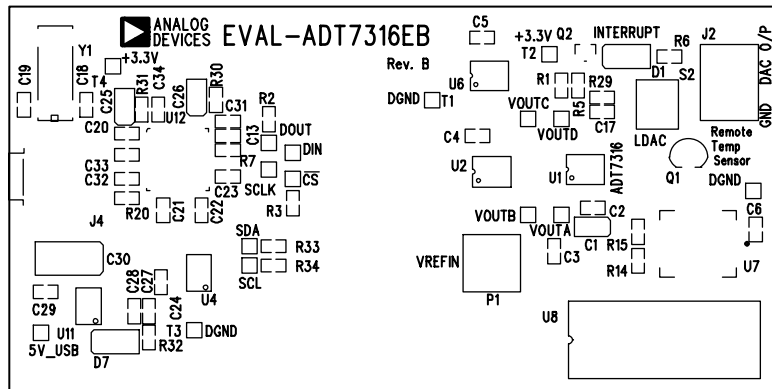| Name	Part Type	Value	Tolerance	Description
C1	CAP+	10 uF		10 V tantalum capacitor
C2	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C3	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C4	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C5	CAP+	10 uF		10 V tantalum capacitor
C6	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C7	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C8	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C9	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C10	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C11	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C12	CAP	0.1 uF		16V X7R multilayer ceramic capacitor
C14	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C15	CAP+	47 uF		10 V tantalum capacitor
C16	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
C17	CAP	0.1 uF		16 V X7R multilayer ceramic capacitor
D1	LED			Red SMD light emitting diode
D2	LED			Green SMD light emitting diode
D3	SD103C			Schottky diode
D4	SD103C			Schottky diode
D5	SD103C			Schottky diode
D6	SD103C			Schottky diode
DIN	TESTPOINT			Red testpoint
DOUT	TESTPOINT			Red testpoint
GND1	TESTPOINT			Black testpoint
GND2	TESTPOINT			Black testpoint
GND3	TESTPOINT			Black testpoint
GND4	TESTPOINT			Black testpoint
INT	TESTPOINT			Red testpoint
J1	USB			USB_RECPTACLE_B
J2	CON\POWER			2-pin terminal block (5 mm pitch)
J3	CON\POWER4			4-pin terminal block (5 mm pitch)
P1	SMB			50 Ω SMB jack
Q1	2N3906			PNP bipolar transistor
Q2	BC807-40LT1			Low power bipolar transistor
R1	RES	1K	1%	0.063 W resistor
R2	RES	2K2	1%	0.063 W resistor
R3	RES	4K7	1%	0.063 W resistor
R4	RES	2K2	1%	0.063 W resistor
R5	RES	10K	1%	0.063 W resistor
R6	RES	1K	1%	0.063 W resistor
R8	RES	2K2	1%	0.063 W resistor
R9	RES	2K2	1%	0.063 W resistor
R10	RES	2K2	1%	0.063 W resistor
R11	RES	2K2	1%	0.063 W resistor
R12	RES	2K2	1%	0.063 W resistor
R13	RES	2K2	1%	0.063 W resistor
R14	RES	3K9	1%	0.063 W resistor
R15	RES	1K2	1%	0.063 W resistor

Name	Part Type	Value	Tolerance	Description
R16	RES	2K2	1%	0.063 W resistor
R17	RES	22K	1%	0.063 W resistor
R18	RES	2K2	1%	0.063 W resistor
R19	RES	2K2	1%	0.063 W resistor
R21	RES	22K	1%	0.063 W resistor
R22	RES	2K2	1%	0.063 W resistor
R23	RES	2K2	1%	0.063 W resistor
R24	RES	2K2	1%	0.063 W resistor
R25	RES	2K2	1%	0.063 W resistor
R26	RES	2K2	1%	0.063 W resistor
R27	RES	2K2	1%	0.063 W resistor
R28	RES	2K2	1%	0.063 W resistor
R29	RES	10K	1%	0.063 W resistor
S1	SW-SPDT-SLIDE			SPDT slide switch
S2	SW-PUSH-SMD			SMD push button switch (sealed 6 mm x 6 mm)
SCL	TESTPOINT			Red testpoint
SCLK	TESTPOINT			Red testpoint
SDA	TESTPOINT			Red testpoint
U1	ADT7316			Temperature sensor
U2	ADG715			Octal SPST switch
U3	ADG715			Octal SPST switch
U5	24LC64			
U6	AD780			Voltage reference
U7	LM3914			
U8	LED_BAR_ARRAY			LED bar array
U9	CY7C68013-CSP			
U10	ADP3303-3.3			
VOUTA	TESTPOINT			Red testpoint
VOUTB	TESTPOINT			Red testpoint
VOUTC	TESTPOINT			Red testpoint
VOUTD	TESTPOINT			Red testpoint
Y1	XTAL-CM309S	24 MHz		Plastic SMD crystal

ORDERING GUIDE

Model	Description
EVAL-ADT7316EB	Evaluation Board

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

WARNING!
ESD SENSITIVE DEVICE

NOTES

NOTES

www.analog.com