Evaluating the **ADE1201** Single Channel, Configurable, Isolated Digital Input

**FEATURES**
- Fully featured evaluation board for the **ADE1201**
- PC control in conjunction with the SDP **EVAL-SDP-CB1Z** controller board
- PC software for control and data analysis
- Standalone capability

**EVALUATION KIT CONTENTS**
- **EVAL-ADE1201EBZ**

**ADDITIONAL EQUIPMENT NEEDED**
- **EVAL-SDP-CB1Z** (must be ordered separately), includes a mini USB cable
- Voltage signal source
- PC running Windows 10 with USB 2.0 port

**DOCUMENTS NEEDED**
- **ADE1201** data sheet
- **ADE1201** schematic
- **ADE1201** PCB layout
- **ADE1201** bill of materials

**SOFTWARE NEEDED**
- **EVAL-ADE120xEBZ** evaluation software

**GENERAL DESCRIPTION**

The EVAL-ADE1201EBZ is a fully featured evaluation board designed to evaluate the **ADE1201** single channel, configurable, isolated digital binary input IC performance in a context similar to a real binary input interface application. The system demonstration platform (SDP) **EVAL-SDP-CB1Z** controller board (SDP-B) must be purchased separately from the evaluation kit. The evaluation kit includes evaluation software, written in LabVIEW®, which provides access to the registers and features of the device through a PC interface.

For full specifications on the **ADE1201**, consult the **ADE1201** data sheet, which must be used in conjunction with this user guide when using the EVAL-ADE1201EBZ.
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REVISION HISTORY

12/2019—Revision 0: Initial Version
Figure 1. EVAL-ADE1201EBZ (Left) Connected to the SDP-B Board (Right)
EVALUATION BOARD CONNECTION DIAGRAM

Figure 2. Evaluation Board Connection Diagram Showing Direct Connection to SDP-B Board
EVALUATION BOARD HARDWARE

OVERVIEW

The EVAL-ADE1201EBZ and the SDP-B (also referred to as the Blackfin® SDP board) are both required to evaluate the ADE1201. When ordering the EVAL-ADE1201EBZ, also order the SDP-B board. The evaluation kit and the SDP-B board are purchased and packaged separately, but must be used together.

The EVAL-ADE1201EBZ is connected to the SDP-B board using the 120-pin connector, P10, as shown in Figure 2. The SDP-B board has an ADSP-BF527 microcontroller that handles all communications from the PC to the eight ADE1201 devices on the EVAL-ADE1201EBZ.

For certain types of electromagnetic compatibility (EMC) and electromagnetic interface (EMI) testing, the SDP-B board and the PC must be separated from the EVAL-ADE1201EBZ. One way to separate these devices from the EVAL-ADE1201EBZ is to isolate the signals sent between the SDP-B board and the EVAL-ADE1201EBZ using a fiber optic interface. Connections to the serial port interface (SPI) and the digital output (DOUT1) signals from the eight ADE1201 devices under test (DUTs) are available via the P9 connector.

POWERING UP THE EVALUATION BOARD

The EVAL-ADE1201EBZ can be powered either by an external dc power supply or by the SDP-B board. The SDP-B board is powered through the USB connection from the PC. The EVAL-ADE1201EBZ can be powered through one of the following methods:

- Through an external 3.3 V power supply. Connect the power supply to the TP_P3V3 and GND1 terminals. Jumper P11 and Jumper JP1 must be open.
- Through the SDP-B board. Short Jumper JP1 and short Pin 1 and Pin 2 on Jumper P11, which is the default method to power the EVAL-ADE1201EBZ.

When the EVAL-ADE1201EBZ is powered on, the D_P3V3 light emitting diode (LED) is illuminated green.

Table 1 and Table 2 list the test points, terminals, jumpers, and connectors on the EVAL-ADE1201EBZ.

ANALOG INPUTS

The ADE1201 channels are designed to work with high voltage digital inputs from ±10 V to ±300 V. The input signals connect to the terminal blocks (P0 to P7) on the EVAL-ADE1201EBZ. Connect the BI+ input to Pin 1 and the BI− input to Pin 2 for each connector. All high voltage input signals are passed through an EMI or EMC compliant, reverse polarity protected application circuit before the signals are connected to the ADE1201. The components used on the EVAL-ADE1201EBZ are the recommended values and types to use with the ADE1201. Refer to the ADE1201 bill of materials or the ADE1201 data sheet for more details.

There are eight ADE1201 devices on the EVAL-ADE1201EBZ. Table 1 identifies which EVAL-ADE1201EBZ terminal block corresponds to each ADE1201 device.

Table 1. EVAL-ADE1201EBZ Channel Assignment

<table>
<thead>
<tr>
<th>Device</th>
<th>Binary Input</th>
<th>EVAL-ADE1201EBZ Input Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADE1201, U0</td>
<td>1</td>
<td>P0</td>
</tr>
<tr>
<td>ADE1201, U1</td>
<td>2</td>
<td>P1</td>
</tr>
<tr>
<td>ADE1201, U2</td>
<td>3</td>
<td>P2</td>
</tr>
<tr>
<td>ADE1201, U3</td>
<td>4</td>
<td>P3</td>
</tr>
<tr>
<td>ADE1201, U4</td>
<td>5</td>
<td>P4</td>
</tr>
<tr>
<td>ADE1201, U5</td>
<td>6</td>
<td>P5</td>
</tr>
<tr>
<td>ADE1201, U6</td>
<td>7</td>
<td>P6</td>
</tr>
<tr>
<td>ADE1201, U7</td>
<td>8</td>
<td>P7</td>
</tr>
</tbody>
</table>

Table 2. EVAL-ADE1201EBZ Jumpers, Test Points, and Connectors

<table>
<thead>
<tr>
<th>Jumpers, Test Points, and Connectors</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP_P3V3</td>
<td>Test point, connects to an external 3.3 V supply to power the ADE1201</td>
</tr>
<tr>
<td>GND1, GND2</td>
<td>GND test points</td>
</tr>
<tr>
<td>P11</td>
<td>3-pin jumper, connects the input of the U9 on-board regulator to either the SDP-B board 5 V supply or to an external voltage source</td>
</tr>
<tr>
<td>P12</td>
<td>2-pin connector, connects the EVAL-ADE1201EBZ to the 5 V external supply</td>
</tr>
<tr>
<td>JP1</td>
<td>2-pin jumper, connects the 3.3 V output of the U9 on-board regulator to power the ADE1201 ICs</td>
</tr>
<tr>
<td>P9</td>
<td>26-pin SPI and DOUT1 breakout connector</td>
</tr>
<tr>
<td>P10</td>
<td>120-pin SDP connector</td>
</tr>
<tr>
<td>P8</td>
<td>3.3 V (output of U9 regulator)</td>
</tr>
</tbody>
</table>

DIGITAL INPUT AND OUTPUT

The ADE1201 devices are connected to a common SPI bus on the EVAL-ADE1201EBZ. One SPI bus with one CS line is used to address all eight ADE1201 devices using the hardware addressing feature of the ADE1201 device.
EVALUATION BOARD SOFTWARE

The EVAL-ADE1201EBZ is supported by the Windows®-based EVAL-ADE120xEBZ evaluation software that allows the user to access the functionalities of the ADE1201. The EVAL-ADE120xEBZ evaluation software communicates with the SDP-B board using the USB port of the PC. The SDP-B microcontroller communicates with the ADE1201 on the EVAL-ADE1201EBZ to process the requests sent from the PC. The installation file is named EVAL-ADE1201 Evaluation Software.

Before installing the EVAL-ADE120xEBZ evaluation software, take the following steps to uninstall any previous version of the EVAL-ADE120xEBZ evaluation software:

1. Click the Add/Remove Programs option in the Windows Control Panel.
2. Select the previous version of the EVAL-ADE120xEBZ evaluation software to uninstall and click Add/Remove.

INSTALLING THE DRIVERS

Administrator privileges are necessary to install and run the EVAL-ADE120xEBZ evaluation software. Disconnect the SDP-B board from the PC before installing the EVAL-ADE120xEBZ evaluation software. All drivers required for running the EVAL-ADE120xEBZ evaluation software are packaged with the installer.

INSTALLING THE EVAL-ADE120xEBZ EVALUATION SOFTWARE

The software package contains an installer that installs the EVAL-ADE120xEBZ evaluation software. The EVAL-ADE120xEBZ evaluation software is a LabVIEW-based program that runs on the PC. Refer to the README file in the installation folder to access a link to install the appropriate LabVIEW run-time engine before installing the EVAL-ADE120xEBZ evaluation software.

To install and launch the EVAL-ADE120xEBZ evaluation software, take the following steps:

1. Navigate to EVAL-ADE120xEBZ > Installer > Volume in the software package. Double-click the setup.exe file to launch the setup program that automatically installs all the software components (including the uninstall program) and creates the required directories.
2. To launch the EVAL-ADE120xEBZ evaluation software, click Start > All Programs > ADE120X and then click EVAL-ADE120xEBZ_Evaluation_Software. When starting the EVAL-ADE120xEBZ evaluation software for the first time, it may be required to right-click the EVAL-ADE120X_Evaluation_Software.exe file and select Run as the Administrator.

To uninstall the EVAL-ADE120xEBZ evaluation software program and the run-time engine, use the Add/Remove Programs option in the Windows Control Panel.

MAIN WINDOW

When the software executable opens, the main EVAL-ADE120xEBZ evaluation software window appears, as shown in Figure 3. When the main window opens for the first time, the evaluation software prompts the user to select the matching hardware, as shown in Figure 4. Click Select to proceed.
The SDP code version and other pertinent hardware information are displayed in the Connection Data window, as shown in Figure 5. To open the Connection Data window shown in Figure 5, click the Window menu in the main EVAL-ADE120xEBZ evaluation software window and click Connection Info in the dropdown menu.

Connect all necessary hardware and power up the EVAL-ADE1201EBZ before using the software windows for communication.

![Figure 5. Connection Data Window](image)
EVALUATION SOFTWARE FUNCTIONS
The main software window (see Figure 3) consists of five options to evaluate a particular functionality of the ADE1201. The five options available for evaluation include the following:

- User Config Registers
- Interrupt & DOUT
- ADC Scope
- MTR Scope
- Interrupts Detect

Click any of these five options to open a corresponding window. To close any of these windows, click the Close button. Multiple windows can be left open on the monitor to evaluate the different ADE1201 features simultaneously.

AUTO IDENTIFICATION
There are eight ADE1201 devices on each EVAL-ADE1201EBZ that allow the user to set up and test eight binary input channels in total. The EVAL-ADE120xEBZ evaluation software automatically identifies the connected devices using the hardware addressing mode functionality, as shown in Figure 6. After identifying the connected devices, the EVAL-ADE120xEBZ evaluation software populates the register fields with the default values in all windows.

USER CONFIGURATION REGISTERS
The User Config Registers option in the main window allows the user to write to all user configurable registers except the MASK register (see Figure 7). The MASK register is discussed further in the Interrupts Window section.

The ADE1201 powers up with default register values automatically populated in the register fields in the User Config Registers.vi window, as shown in Figure 7. Click Read Registers to read the register values and output the results to the table. Enter the file path in the File Path text box to which the register values are saved. Click Save Registers Value To File to generate a text file of the register values. The saved text file can also be edited and used to write back to the registers. When writing back to the registers, edit the hexadecimal register value in the text file, specify the file in the File Path text box, and then click Load Registers Value From File to update the table in the User Config Registers.vi window with the values from the file. To write to all writable registers within the ADE1201, click Write Registers. The user can edit the hexadecimal register values directly in the User Config Registers.vi window. Differences in the Write field and Read field values are displayed in red text by the EVAL-ADE120xEBZ evaluation software. When either Write Registers or Load Registers Value From File is clicked, the EVAL-ADE120xEBZ evaluation software unlocks the ADE1201, writes the register change to the appropriate device, and then locks the device. To perform a device software reset, click sw reset, as shown in Figure 6.
INTERRUPTS WINDOW

The interrupts window displays the status of all interrupt events. The individual bits of the INT_STATUS register are illuminated with green LEDs in the interrupt window (see Figure 8). If a register LED is illuminated, the corresponding status bit is set to 1. Next to each LED, a checkbox represents the corresponding mask bit. To set the mask bits, select the corresponding checkbox and click Write Mask. Click Clear Flag to reset all status bits simultaneously and to clear the interrupt request.

To view the DOUT1 and IRQ pin logic levels, click Poll DOUT/IRQ. If an INT_STATUS register LED (DOUT1_0 through DOUT1_7) is illuminated, the DOUT1 pins are high. DOUT1 and IRQ are driven by the ADE1201 and can only be polled by the user. If the IRQ LED is illuminated, it means that the active interrupt from any of the eight devices is present on the respective IRQ pin.

Figure 8. Interrupts Window
ADC SCOPE WINDOW

The analog-to-digital converter (ADC) scope window displays the values of the ADC register (Address 0x00E) or the ADCDEC register (Address 0x00F). Select which of the two registers the ADC scope displays using the dropdown menu labeled **ADC** in Figure 9. The registers are updated at 100 kHz. The ADC scope window reads the data at 100 kSPS when a single ADE1201 device is viewed. Set the channel and the number of samples to acquire by entering the correct values in the appropriate text boxes, as shown in Figure 9. The data can be acquired once or continuously, as shown in Figure 9. The ADC scope window is automatically set to normal mode. The ADC scope has two other modes: waveform capture with threshold trigger (WFB THR) mode and waveform capture with interrupt trigger (WFB IRQ) mode. WFB THR mode works the same way as normal mode, except the samples are only captured when the ADC value reaches a specified threshold. In WFB IRQ mode, samples are only captured when a predetermined interrupt occurs. The **Voltage Gain** box reflects the voltage divider ratio of each channel on the EVAL-ADE1201EBZ.

![Figure 9. ADC Scope Window](image)
MTR SCOPE WINDOW
Click the MTR Scope option shown in Figure 3 to open the window shown in Figure 10, which displays the values of the EGY_MTR1 register (Address 0x017). In the ADE1201, EGY_MTR1 is updated at 100 kSPS. The MTR scope window reads the data continuously at 100 kSPS when data for a single ADE1201 device is viewed. The user can set the channel, as shown in Figure 10.

INTERRUPTS DETECT WINDOW
Click the Interrupts Detect option shown in Figure 3 to open the window shown in Figure 11, which allows the user to capture the occurrence of any one of the fifteen interrupts available. To use the interrupts detect window, select at least one interrupt bit and click Start. The EVAL-ADE1201EBZ evaluation software continuously counts the interrupts as the interrupts occur, and the window shows the interrupts count. To stop the accumulation of interrupts, click Stop (see Figure 11).
TROUBLESHOOTING

If the EVAL-ADE120xEBZ evaluation software does not detect the SDP-B board, the message shown in Figure 12 displays.

When this message appears, take the following steps:

1. Verify that the SDP-B board is connected to the PC using the USB cable. When connected, the window in Figure 13 appears in the task bar and Windows installs any necessary drivers.
2. When the window shown in Figure 4 appears, check if the LED on the SDP-B board is flashing. If the LED is flashing, click Select.
EVALUATION BOARD SCHEMATICS AND ARTWORK

The reference design schematics and artwork for the EVAL-ADE1201EBZ are available on the EVAL-ADE1201EBZ webpage. Refer to the ADE1201 data sheet for more details about the layout guidelines and external components in the recommended ADE1201 application circuit.

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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