Evaluating the AD74413R-DIOZ Quad-Channel Software Configurable Input and Output

FEATURES

▶ Quad-channel, software configurable input and output functionality for the AD74413R and the MAX14906
▶ Single, 24 V external supply
▶ On-board MAX14483, 6-channel, low power, 3.75 kV RMS SPI digital isolator
▶ On-board MAX17552, 60 V, 100 mA, ultrasmall, high-efficiency, synchronous step-down DC-to-DC converter
▶ Windows GUI for control

EVALUATION BOARD KIT CONTENTS

▶ EVAL-AD74413R-DIOZ evaluation board

EQUIPMENT NEEDED

▶ USB2PMB2 adapter board
▶ Benchtop power supply and connector cables
▶ PC running Windows 10 or later

DOCUMENTS NEEDED

▶ AD74413R data sheet
▶ MAX14906 data sheet

EVALUATION BOARD PHOTOGRAPH

SOFTWARE NEEDED
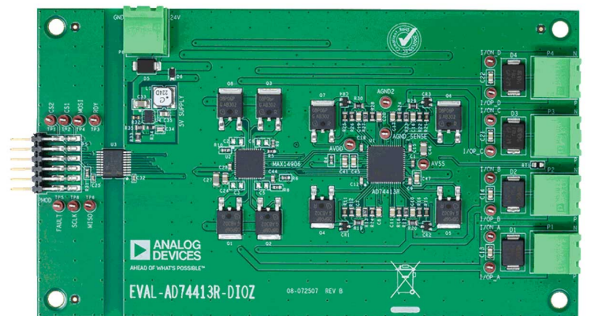
▶ AD74413R-DIOZ demo GUI
▶ .NET Framework 4.8 runtime
▶ FTDI D2XX direct drivers

GENERAL DESCRIPTION

The EVAL-AD74413R-DIOZ (see Figure 1) is an evaluation board used to demonstrate and evaluate the full software configurable input and output (SWIO) features that the AD74413R and the MAX14906 provide when working together. The board has functionality for digital input, digital output, analog input, and analog output.

The EVAL-AD74413R-DIOZ is controlled with a USB2PMB2 adapter board. The USB2PMB2 board controls the EVAL-AD74413R-DIOZ board via the USB port of a PC using the AD74413R-DIOZ demo software.

The EVAL-AD74413R-DIOZ requires an analog power (AVDD) operating supply of 14 V to 28.8 V. The USB2PMB2 board is supplied from the PC.

See the AD74413R data sheet for more information about the AD74413R, and see the MAX14906 data sheet for more information about the MAX14906. Users must consult both data sheets in conjunction with this user guide when using the EVAL-AD74413R-DIOZ.

Figure 1. EVAL-AD74413R-DIOZ Evaluation Board

PLEASE SEE THE LAST PAGE FOR AN IMPORTANT
WARNING AND LEGAL TERMS AND CONDITIONS.

Rev. 0 | 1 of 9

TABLE OF CONTENTS

REVISION HISTORY

**7/2023—Revision 0: Initial Version**

EVALUATION BOARD HARDWARE

POWER SUPPLY

The EVAL-AD74413R-DIOZ comes with a single power supply connector (P6) that directly powers the AVDD pin of the AD74413R and the VDD and VDDx pins of the MAX14906.

The EVAL-AD74413R-DIOZ supply powers an on-board DC-to-DC converter (MAX17552, (U4)) that generates a 5 V supply. This 5 V supplies the DVCC and IOVDD pins of the AD74413R as well as the VL and the V5V pins of the MAX14906.

Figure 2 shows a simplified drawing of the power connections on the EVAL-AD74413R-DIOZ.
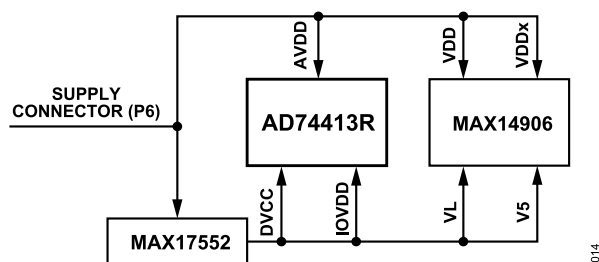
Figure 2. EVAL-AD74413R-DIOZ Simplified Power Diagram

OUTPUT CHANNELS

The AD74413R and the MAX14906 have four channels each (see the AD74413R and MAX14906 data sheets for more information).

Each of the channels in the AD74413R is connected to the respective channel of the MAX14906. For example, Channel A of the AD74413R is connected to Channel 1 of the MAX14906 and so on.

There are four terminal connectors on the EVAL-AD74413R-DIOZ, P1, P2, P3, and P4, that connect the desired loads to the four output channels.

SERIAL PERIPHERAL INTERFACE (SPI) COMMUNICATION

The USB2PMB2 handles the communication to the EVAL-AD74413R-DIOZ board via the PC. The USB2PMB2 board also transmits an OR combination of the $\overline{\text{ALERT}}$ signal of the AD74413R and the $\overline{\text{FAULT}}$ signal of the MAX14906 to the PC so the graphical user interface (GUI) can monitor any of the interrupts and diagnostics that the AD74413R and the MAX14906 provide.

TEST POINTS

The EVAL-AD74413R-DIOZ has test points for the SPI signals, the alert signal, to measure the AVDD, AVSS, and AGND rails, and to provide debug access to the 4-channel screw terminals.

EVALUATION BOARD SOFTWARE

SOFTWARE PREREQUISITES

Before connecting the USB2PMB2 board to the PC, the following two prerequisites must be met for correct evaluation kit behavior.

FTDI D2XX Direct Drivers

The USB2PMB2 board depends on the FTDI D2XX direct drivers to communicate correctly with Windows®. Before connecting the USB2PMB2 board to the PC or installing the AD74413R_DIOZ software, install the FTDI D2XX direct drivers.

These drivers can be downloaded from the FTDI website.

.NET Framework 4.8 Runtime

The AD74413R-DIOZ software GUI uses several .NET library components. Before installing the AD74413R-DIOZ software, confirm that your system has the .NET Framework 4.8 runtime installed. The .NET Framework 4.8 runtime can be downloaded directly from the Microsoft website.

The .NET Framework 4.8 developer pack is not required to run the AD74413R-DIOZ software.

INSTALLING THE AD74413R-DIOZ SOFTWARE

Download the evaluation software from the EVAL-AD74413R-DIOZ web page. Run the **AD74413R_DIOZ_setup.exe** file. Once the installation is complete, restart the PC before opening the software.

GETTING STARTED

After all prerequisites are met and the AD74413R-DIOZ software is installed, the EVAL-AD74413R-DIOZ needs to be connected to both the PC and to the power supply by completing the following:

1. Connect the EVAL-AD74413R-DIOZ board to the USB2PMB2 board via the PMOD connector (P5).
2. Using a USB cable, connect the USB2PMB2 board to the PC.
3. Connect a 24 V power supply to the 24 V power supply connector (P6).

COMMUNICATING WITH THE EVAL-AD74413R-DIOZ

Once the EVAL-AD74413R-DIOZ board has been connected to the PC and to a 24 V power supply, open the AD74413R-DIOZ software. The software checks automatically that the USB2PMB2 board is connected correctly and communicating with the software. If a USB2PMB2 board is not detected by the software, a splash screen shows a warning message (see Figure 3).
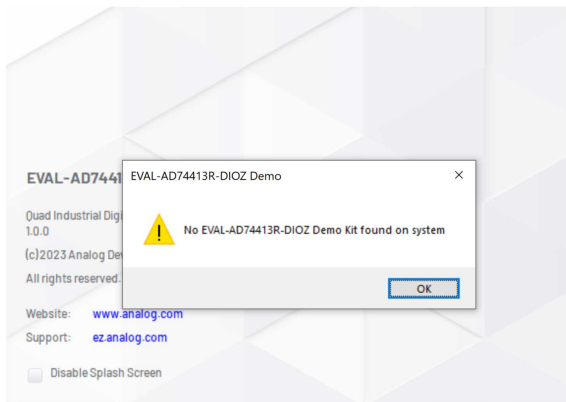
Figure 3. USB2PMB2 Board Not Detected

If communication to the USB2PMB2 board is lost while using the EVAL-AD74413R-DIOZ board and the AD74413R-DIOZ software, the message in the status bar at the bottom of the application window changes from **Connected** to **Kit Not Found** and **Not Connected**. Communication to the USB2PMB2 board is restored by selecting **Search for USB Device** from the **Device** menu. This action reestablishes the USB communication between the PC and the USB2PMB2 board, and the four channels of the EVAL-AD74413R-DIOZ board are reset to a high impedance state.

If communication with the EVAL-AD74413R-DIOZ is lost because of an incorrect supply, the **Board not ready** indicator in the GUI turns red. After the supply returns to a correct value, the **Board not ready** indicator turns gray, and the GUI configures the four channels of the EVAL-AD74413R-DIOZ as high impedance.

Loss of Communication Between EVAL-AD74413R-DIOZ and USB2PMB2

The AD74413R-DIOZ software detects when the board is not ready due to the loss of communication between the PC and

the USB2PMB2 board or due to an incorrect voltage supply to the EVAL-AD74413R-DIOZ only. It does not detect if the EVAL-AD74413R-DIOZ is disconnected from the USB2PMB2 board.

If the EVAL-AD74413R-DIOZ board is disconnected from the USB2PMB2 board and the user wants to connect a new EVAL-AD74413R-DIOZ board, click **Reset SWIO** in the **Device** menu (see Figure 4). This resets the GUI and configures the EVAL-AD74413R-DIOZ to a known high impedance state.
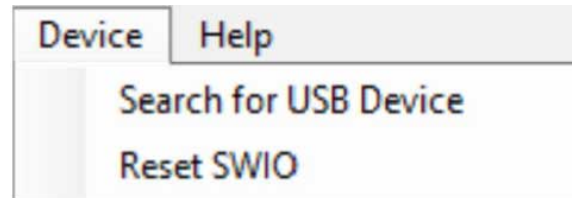

Figure 4. Device Menu

USING THE SOFTWARE

Configuration Tab

The AD74413R_DIOZ software opens to the **Configuration** tab (see Figure 5).

Figure 5. Configuration Tab

The **Configuration** tab contains the following elements:

▶ Top level overview of the EVAL-AD74413R-DIOZ configuration
▶ MAX14906 interrupts
▶ AD74413R interrupts
▶ **Board not ready** indicator
▶ **Configure** button

Top Level Overview

This section of the configuration tab shows the four different channels of the EVAL-AD74413R-DIOZ and what configuration will be applied to the board when the **Configure** button is clicked.

Select the desired mode (high impedance low-leakage mode, digital input, digital output, analog input, or analog output) from the drop-down menu in the first column for the respective board channel (see Figure 6).
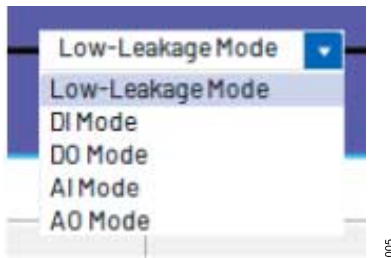
GETTING STARTED

Figure 6. Modes of Operation

Digital Input Mode

When a channel is configured as a digital input, a second dropdown menu and a text box appear (see Figure 7).
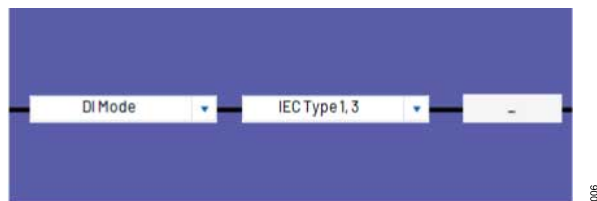

Figure 7. Configuration as Digital Input

The second dropdown menu allows for the channel to be configured as either **IEC Type 1, 3** or as **IEC Type 2**. After the **Configure** button is clicked, the text box on the right displays **High** or **Low** depending on the board signal input.

Digital Output Mode

When a channel is configured as a digital output, three dropdown menus appear on the right of the **DO Mode** dropdown menu (Figure 8).

Figure 8. Configuration as Digital Output

The second dropdown menu allows the channel to be configured as:

▶ **High-side**
▶ **High-side 2x Inrush** current
▶ **Active Clamp Push-Pull**
▶ **Simple Push-Pull**

The third dropdown menu allows configuration of the output of the channel as on or off when working in high-side mode of operation or high or low when working in push-pull mode.

The fourth dropdown menu sets the output current limit.

Analog Input Mode

When a channel is configured as an analog input, another dropdown menu and a text box appear (see Figure 9).
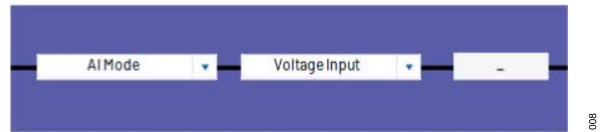
Figure 9. Configuration as Analog Input

The second dropdown menu allows the user to select one of the following analog input modes:

▶ **Voltage Input**
▶ **Current Input—Externally** powered
▶ **Current Input—Loop** powered

After the **Configure** button is clicked, the value corresponding to the signal input into the board appears in the text box.

Analog Output Mode

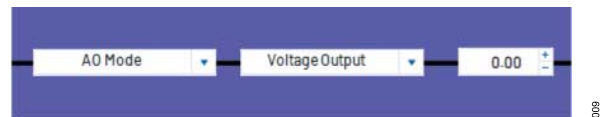When a channel is configured as an analog output, an additional dropdown menu and a numeric box appear (Figure 10).

Figure 10. Configuration as Analog Output

The second dropdown allows users to select between **Voltage Output** mode and **Current Output** mode.

The numeric box is used to select the desired current or voltage output value for the channel.

MAX14906 Interrupts

The EVAL-AD74413R-DIOZ has all of the interrupt sources from the MAX14906 unmasked. If any of the MAX14906 interrupts are signaled, the corresponding interrupt flag in the AD74413R-DIOZ GUI turns red (Figure 11).

For more information about the particular interrupt source, please consult the MAX14906 data sheet.

The **Clear** button clears all of the interrupts signaled in the MAX14906 (if the fault conditions that generated the interrrupts are resolved).
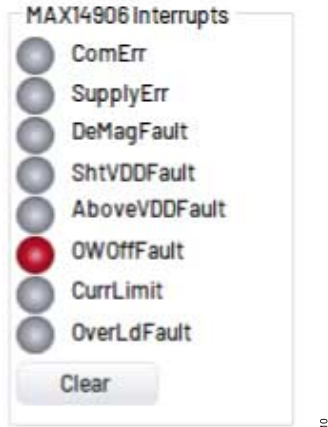
GETTING STARTED

Figure 11. MAX14906 Interrupts

AD74413R Interrupts

All of the interrupt sources of the AD74413R are unmasked in the EVAL-AD74413R-DIOZ board. When an interrupt is signaled, the corresponding flag in the AD74413R-DIOZ GUI turns red (see Figure 12).

For more information about the different interrupts, please consult the AD74413R data sheet.

The **Clear** button clears all of the interrupts signaled in the AD74413R (if the fault conditions that generated the interrupts are resolved).
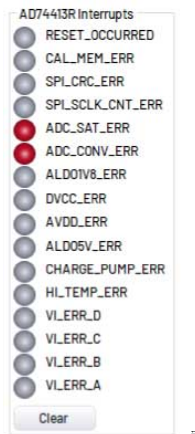
Figure 12. AD74413R Interrupts

Board Not Ready Indicator

When the supply to the EVAL-AD74413R-DIOZ is not correct, the **Board not ready** indicator is flagged in red. Once the supply returns to the correct level, the indicator turns back to gray, and all of the channels are reset to a high impedance status.

Configure Button

Click the **Configure** button for the AD74413R-DIOZ GUI to configure the EVAL-AD74413R-DIOZ board channels as chosen in the **Configuration** tab.

The EVAL-AD74413R-DIOZ board is only configured by clicking the **Configure** button and not by making selections from the dropdown menus.

MAX14906 Diagnostics Tab

Several of the MAX14906 interrupts have different sources that can trigger them. When a MAX14906 interrupt is flagged in the **Configuration** tab, the **MAX14906 Diagnostics** tab provides further details about which of the different sources in the MAX14906 triggered the interrupt.
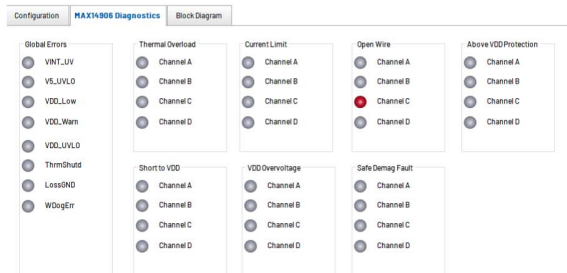
Figure 13. MAX14906 Diagnostics Screen

When the interrupts are cleared by clicking the **Clear** button in the **Configuration** tab, the **MAX14906 Diagnostics** tab is updated automatically.

For more information about the different interrupt sources, please consult the MAX14906 data sheet.

Block Diagram Tab

The **Block Diagram** tab detects what configuration is selected for the respective channel in the **Configuration** tab and displays a simplified block diagram of the system that shows how the devices on the board work in the selected configuration.
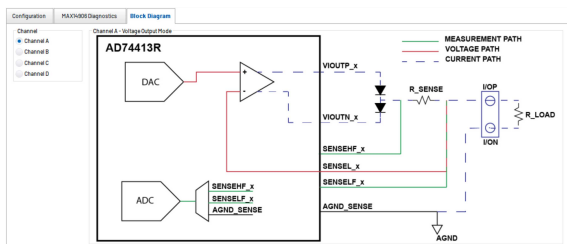

Figure 14. Block Diagram Tab

ORDERING INFORMATION

BILL OF MATERIALS

Qty	Designator	Description	Manufacturer	Part Number
19	AGND2, AGND_SENSE, AVDD, AVSS, I/ON_A, I/ON_B, I/ON_C, I/ON_D, I/OP_A, I/OP_B, I/OP_C, I/OP_D, TP1, TP2, TP3, TP4, TP5, TP6, TP8	PCB connector test points, red	Vero Technologies	20-313137
1	C1	Ceramic capacitor, 0.33 µF, 16 V, 20%, X7R 0603	Samsung	CL10B334KO8NNNC
12	C7, C8, C10, C11, C13, C14, C16, C17, C19, C20, C21, C22	Ceramic capacitors, 0.01 µF, 50 V, 5%, C0G 0805	Murata Manufacturing Co.	GRM2195C1H103JA01D
4	C9, C12, C15, C18	Ceramic capacitors, 220 pF, 100 V, 5%, C0G 0603	Visahy Intertechnology	VJ0603A221JXBAC
5	C23, C26, C27, C29, C46	Ceramic capacitors, 10 µF, 50 V, 10%, X7R 1206	Samsung	CL31B106KBHNNNE
1	C24	Ceramic capacitor, 1 µF, 100 V, 10%, X7S 0805	Murata Manufacturing Co.	GRJ21BC72A105KE11L
2	C25, C32	Ceramic capacitors, 0.1 µF, 35 V 10%, X7R 0402 AEC-Q200, low effective series resistance	TDK Corporation	CGA2B3X7R1V104K050BB
2	C28, C44	Ceramic capacitors, 0.1 µF, 100 V, 10%, X7R 0603	YAGEO Corporation	CC0603KRX7R0BB104
8	C4, C30, C31, C38, C40, C42, C45, C47	Ceramic capacitors 0.1 µF, 50 V, 10%, X7R 0805 AEC-Q200	AVX Corporation	08055C104K4T4A
1	C33	Ceramic capacitor, 1 µF, 100 V, 10%, X7R 1206 AEC-Q200	Murata Manufacturing Co.	GCJ31CR72A105KA01L
1	C34	Ceramic capacitor, 0.22 µF, 10 V, 20%, X7R 0306, low effective series inductance	Murata Manufacturing Co.	LLL185R71A224MA01L
1	C35	Ceramic capacitor, 10 µF, 6.3 V, 10%, X7R 0805 AEC-Q200	Murata Manufacturing Co.	GCM21BR70J106KE22L
1	C36	Ceramic capacitor, 0.1 µF, 25 V, 10%, X7R 0603	KEMET Corporation	C0603C104K3RACTU
2	C37, C39	Ceramic capacitors, 2.2 µF, 10 V, 10%, X7R 0805	YAGEO Corporation	CC0805KKX7R6BB225
1	C41	Ceramic capacitor, 10 µF, 16 V, 10%, X5R 0805	Murata Manufacturing Co.	GRM21BR61C106KE15L
1	C43	Ceramic capacitor, 1 µF, 35 V, 10%, X7R 0805	TAIYO YUDEN CO.	GMK212B7105KG-T
4	CR1, CR2, CR3, CR4	Dual series switching diodes, 0.215 A	ON Semiconductor	BAV99WT1G
4	D1, D2, D3, D4	TVS bidirectional diodes	STMicroelectronics	SMCJ40CA-TR
1	D5	TVS bidirectional diode	Fairchild Semiconductor International Inc.	SMBJ36CA
1	D6	Schottky diode barrier rectifier	Vishay Intertechnology	MSS1P6-M3/89A
1	L1	Low profile shielded power inductor, 220 µH, 20%, 0.5 A, 1.35 Ω	Coilcraft Inc.	LPS5030-224MRC
5	P1, P2, P3, P4, P6	PCB connector header, two positions	Phoenix Contact	1759017
1	P5	PCB connector, 12 positions, male header, double row-RA, 5.84 mm post length, 2.54 mm pitch	Samtec, Inc.	TSM-106-01-F-DH
8	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	MOSFET power transistor, p-channel, 60 V, 8.83 A, 0.23 Ω, TO-252 (DPAK)	Infineon Technologies	SPD08P06PGBTMA1
1	R1	SMD resistors, 33 kΩ, 0.1%, 1/8 W, 0805 AEC-Q200 high reliability	Panasonic	ERA-6AEB333V
8	R4, R5, R6, R7, R8, R9, R10, R31	SMD resistors, 10 kΩ, 1%, 1/10 W, 0603 AEC-Q200	Panasonic	ERJ-3EKF1002V
4	R11, R15, R21, R25	SMD resistors 2 kΩ, 0.1%, 1/10W, 0805 HIGH POWER	TE Connectivity	RN73C2A2K0BTG
8	R12, R14, R16, R18, R22, R24, R26, R28	SMD resistors 10 kΩ, 1%, 1/8W, 0805 AEC-Q200	Panasonic	ERJ-6ENF1002V
4	R13, R17, R23, R27	SMD resistors 2 kΩ, 1%, 1/8 W, 0805 AEC-Q200	Panasonic	ERJ-6ENF2001V
4	R19, R20, R29, R30	SMD resistors 100 Ω 0.1%, 1/8 W, 0805, high precision - high stability	YAGEO Corporation	RT0805BRB07100RL
1	R2	SMD resistor 0 Ω jumper, 1/10 W, 0402 AEC-Q200	Panasonic	ERJ-2GE0R00X
1	R32	SMD resistor 191 kΩ ,1% 1/10 W, 0603 AEC-Q200	Vishay Intertechnology	CRCW0603191KFKEA

ORDERING INFORMATION

Qty	Designator	Description	Manufacturer	Part Number
1	R33	SMD resistor 49.9 kΩ, 1% 1/8 W, 0805 AEC-Q200	Panasonic	ERJ-6ENF4992V
1	R34	SMD resistor 22.1 Ω, 1% 1/10 W, 0603 AEC-Q200	Panasonic	ERJ-3EKF22R1V
1	R35	SMD resistor 261 kΩ, 1% 1/8 W, 0805	YAGEO Corporation	RC0805FR-07261KL
1	RT1	NTC thermistor resistor, 33 kΩ, 5%, 0805 AEC-Q200	Vishay Intertechnology	NTCS0805E3333JHT
1	U1	Quad-channel, software configurable input and output	Analog Devices, Inc.	AD74413RBCPZ
1	U2	Quad-channel industrial digital output, digital input	Analog Devices, Inc.	MAX14906ATM+
1	U3	6-channel, low power, 3.75 kV RMS SPI digital isolator	Analog Devices, Inc.	MAX14483AAP+
1	U4	60 V, 100 mA, ultrasmall, high-efficiency, synchronous step-down DC-to-DC converter with 22 µA no-load supply current	Analog Devices, Inc.	MAX17552ATB+

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.