

# EV-TEMPSENSE-ARDZ User Guide UG-1656

One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

### Using the EVAL-ADT7420ARDZ Shield with Arduino or Linduino Hardware

#### **FEATURES**

Fully featured Arduino shield for the ADT7410, ADT7420, ADT7310, and ADT7320

PC control in conjunction with the Arduino IDE

### **EVALUATION KIT CONTENTS**

#### **EV-TEMPSENSE-ARDZ kit**

EVAL-ADT7420ARDZ evaluation board (shield) EVAL-ADT7420MBZ remote evaluation board EVAL-ADT7320MBZ remote evaluation board 2 plastic screws and washers 6-way and 4-way ribbon cables

#### **EQUIPMENT NEEDED**

Arduino or Linduino development board USB cable (A type end to B type end) PC or laptop running Windows® 10 operating system

#### SOFTWARE NEEDED

#### LTSketchbook

ADT7420 No-OS driver Arduino IDE

#### **ONLINE RESOURCES**

**Evaluation board schematics and bill of materials** 

#### **GENERAL DESCRIPTION**

The ADT7410, ADT7420, ADT7310, and ADT7320 are high accuracy digital temperature sensors offering breakthrough performance over a wide industrial temperature range. The devices contain an internal band gap reference, a temperature sensor, and a 16-bit analog-to-digital converter (ADC) to monitor and digitize the temperature to 0.0078°C resolution. The devices are available in I<sup>2</sup>C or SPI versions.

The EV-TEMPSENSE-ARDZ is an evaluation board kit that allows easy evaluation of the ADT7410, ADT7420, ADT7310, and ADT7320 precision digital temperature sensors. Users can interface to these sensors on the Arduino evaluation board (shield), or with the ribbon cable connected to the external sensors. Consult the ADT7410, ADT7420, ADT7310, and ADT7320 data sheets in conjunction with this user guide when using the EV-TEMPSENSE-ARDZ with the Arduino integrated development environment (IDE).



#### **EV-TEMPSENSE-ARDZ FUNCTIONAL BLOCK DIAGRAM**

Figure 1.

# UG-1656

# **EV-TEMPSENSE-ARDZ** User Guide

## **TABLE OF CONTENTS**

Features 1
Evaluation Kit Contents1
Equipment Needed 1
Software Needed 1
Online Resources
General Description
EV-TEMPSENSE-ARDZ Functional Block Diagram 1
Revision History
Evaluation Board Hardware

### 

#### **REVISION HISTORY**

10/2019—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE hardware setup

The EV-TEMPSENSE-ARDZ development kit contains the following boards (see Figure 2 to Figure 4):

- The EVAL-ADT7420ARDZ shield
- The EVAL-ADT7420MBZ remote evaluation board
- The EVAL-ADT7320MBZ remote evaluation board

Place the EVAL-ADT7420ARDZ shield on top of the Arduino<sup>™</sup> development board by matching up the EVAL-ADT7420ARDZ shield power with the P4, P5, P6, and P7 analog and digital connectors (see Figure 5).

Connect the 4-way ribbon cable and the external EVAL-ADT7420MBZ printed circuit board (PCB) to Connector P1 on the EVAL-ADT7420ARDZ shield.

Connect the 6-way ribbon cable and the external EVAL-ADT7320MBZ PCB to Connector P2 on the EVAL-ADT7420ARDZ shield.

See Figure 5 for a connection diagram of all of the boards.

### LOCATION OF EVALUATION BOARD SCHEMATICS

The evaluation board schematic diagrams and bill of materials are included with all the supporting documentation on the EV-TEMPSENSE-ARDZ product page.

#### **POWER SUPPLIES**

The EVAL-ADT7420ARDZ shield is powered by the 5 V power supply from the Arduino development board and this power supply is regulated to either 3.0 V or 3.3 V, selected by the EVAL-ADT7420ARDZ, JP1. The default setting of the power supply is 3.0 V. Alternatively, the EVAL-ADT7420ARDZ shield can be powered externally via P10, which is selected by changing the JP2 jumper Position B.

The EVAL-ADT7420MBZ and the EVAL-ADT7430MBZ evaluation boards are powered with the same 5 V power supply, but are selected by P1 and P2, respectively.



Figure 2. EVAL-ADT7420ARDZ Evaluation Board



1658-004

Figure 3. EVAL-ADT7420MBZ Evaluation Board



Figure 4. EVAL-ADT7320MBZ Evaluation Board



Figure 5. Hardware Connected Diagram

#### **INSTALLING THE ARDUINO IDE**

Download the latest version of the Arduino software from the **Arduino IDE** link located under the **Setup** section from the www.analog.com/en/design-center/evaluation-hardware-and-software/linduino site. For more information on how to install the Arduino IDE, visit the Arduino home page.

### **INSTALLING THE LTSKETCHBOOK**

To install and set up the LTSketchbook, take the following steps:

- 1. If using the Linduino hardware for the first time, visit the Linduino page at www.analog.com/en/design-center/ evaluation-hardware-and-software/linduino.html for instructions on how to install the LTSketchbook.
- Download the latest Linduino sketchbook, LTSketchbook.zip, from www.analog.com/media/en/ engineering-tools/design-tools/LTSketchbook.zip. This zip file contains the entire code base for the Linduino board, which includes all demo code, libraries for individual devices, and auxiliary functions.
- 3. Extract this zip file (right click the file) to a location for working files, such as the **Documents** folder.
- To change the Arduino IDE settings to use the LTSketchbook, open the Arduino IDE software and navigate to File > Preferences, which opens the window shown in Figure 6.

			×
Settings Network			
Sketchbook location:			
C:\Users\bsomers\OneDrive	- Analog Devices, Inc\Documents\Arduino\LTSketchbook		Browse
Editor language:	System Default	(requires restart of Arduit	no)
Editor font size:	17		
Interface scale:	Automatic 100 \$% (requires restart of Arduin	o)	
Theme:	Default theme v (requires restart of Arduino)		
Show verbose output during:	compilation upload		
Compiler warnings:	None 👻		
Display line numbers			
Enable Code Folding			
Verify code after upload			
Use external editor			
Aggressively cache comp	fied core		
Check for updates on star	rtup		
Update sketch files to nev	w extension on save (.pde -> .ino)		
Save when verifying or up	ploading		
Additional Boards Manager U	RLs;		0
More preferences can be edit	ed directly in the file		
C:\Users\bsomers\AppData\L	ocal\Arduino15\preferences.txt		

Figure 6. Arduino IDE Preferences Window

 In the Sketchbook location field shown in Figure 6, click Browse and locate the path to the extracted LTSketchbook.zip file. The correct file location is shown in the LTSketchbook option in the Look in dropdown menu and the following seven subdirectories are shown: Active Learning, Documentation, Example Designs, libraries, Part Number, User Contributed, and Utilities (see Figure 7).

## **EV-TEMPSENSE-ARDZ** User Guide



Figure 7. LTSketchbook Location

 Note that changing the LTSketchbook location affects how the built in compiler reads the libraries saved on the default Arduino/libraries folder. This folder is automatically created after installing the Arduino.

#### ADT7420 NO OPERATING SYSTEM (NO-OS) DRIVER

Download the **adt720.h** and **adt7420.c** files, required to operate the No-OS driver, from the Analog Devices, Inc., GitHub repository, as shown in Figure 8. Go to www.github.com/ analogdevicesinc/no-OS to download the files.

The No-OS driver path is **no-OS/drivers/temperature/adt7420**/ (see Figure 8).

analogdevicesin	c/no-05	S Website 102	🗙 Star 2	IS Yrock 948
>Code @ Inues	t# ∩ Pull requests #	(i) inégrits		
andic master * DD	OS / drivers / temperature / adt7420 /		Onlie new the	Find file Hictory
aniclas ant mice	subgetions allowers resource address to the based on films. Said		Latest core	nit kohole yesterday
-				(a 2001) (1) (1-
8017420.0	ativets move addrivence beader, these			a roses age
(HCE7420.9)	drivers make solarity with header files			4 hoom age ;

Figure 8. Analog GitHub Repository

In the **LTSketchbook/libraries** folder automatically created after Step 3 in the Installing the LTSketchbook section (see Figure 7), create a new folder and name it **adt7420**. Copy and paste the **adt7420.h** and **adt7420.c** files into the newly created **adt7420** folder, as shown in Figure 9.

10		dt7420									-		×
File	Home	Share View											<ul> <li>€</li> </ul>
A Pin to Quick access	Copy	Paste Cut Paste Paste shortcut	Marer 55 *	Conv to"	X Delete	Rename	New folder	間· 10・	Properties	Copen *	Select	all none selection	
	0	phoard		Org	anize		Ne	EW.	0	pen	Se	ect.	
<del>(</del> • •)	- 1	😽 🗠 Documents 🤞 Ardui	no + LTSI	ketchbo	ook + I	braries +	adt742	0	~ 0	Search ad	17420		P
. ^	Name			Da	te modif	ed	Type		Size				-
A-101	🗖 adt	7420.c		- 26	06/2019	15:25	TrueST	VDIO C	file	10 KB			
Ø v 2 items	🖸 edt	7420.h		26	06(2019	15:25	TrueST	UDIO H	file	7.68		F	

1658-008

Figure 9. Documents/Arduino/LTSketchbook/libraries/adt7420 Folder

21658-012

21658-014

### LOAD EXAMPLE SKETCH

After downloading and placing all files in the correct location, take the following steps to load an example sketch from the LTSketchbook:

 Close and open a new Arduino IDE. In the Arduino IDE, navigate to File > Sketchbook > LTSketchbook > Part Number > ADI-Parts > EVAL-ADT7420 (see Figure 10). A new window opens with the EVAL-ADT7420ARDZ example software. This software allows the user to use the EVAL-ADT7420ARDZ shield with the Arduino board.

New Open Open Recent	Ctrl+N Ctrl+O							
Sketchbook		LTSketchbook	Active Learning	>Y DIRECT,	INDIRECT,			
Examples Close Ctrl+W		Ctrl+W		<ul> <li>DAMAGES (INCLUDING, BU MENT OF SUBSTITUTE GOO</li> </ul>				
Save	Ctrl+S	THEORY OF LIA	Part Number	1000	FRICT LIABILITY.			
Save As	Ctrl+Shift+S	IG NEGLIGENCE O	User Contributed	2000	> C OUT OF THE USE			
Dama Catura	Chill Shift D	EVEN IF ADVIS	Utilities	3000	> DAMAGE .			
Page Setup	Ctrl+D	***************		4000	>			
Phint	Ctn+P			5000	>			
Preferences	Ctrl+Comma			6000	>			
Ouit	Ctrl+O	1>		9000	>			
4 tinglude	CREPROM by	lace.h>		ADI-Parts	AD5933			
5 \$include	<platform< td=""><td></td><td>EVAL-AD5686R</td></platform<>		EVAL-AD5686R					
6 extern "	C" (				EVAL-AD5696R			
7 #include	"adt7420.1	1"			EVAL-AD7124-8			
8 };					EVAL-ADT7420			

Figure 10. Arduino IDE Load Sketch Example

 Plug the Arduino board to the PC via the USB cable. Select the board type and serial port by navigating to Tools > Port and select the serial device of the board as shown in Figure 11.

EV	D AL-A	DT742	Auto Format Ct Archive Sketch Fix Forceding & Beload	T+T
31 32 33 34 35 36 37	* * * * * * *	IN NO INCI LIMI SERV CAUSI OR TO OF TI	Manage Libraries CCI Serial Monitor CCI Serial Plotter CCI WiF1101 / WiFININA Firmware Updater Board: "Arduino/Genuino Lino"	+Shit+I ANY DIRECT, INDIRECT, +Shit+M AL DAMAGES (INCLUDING, BUT NO UREMENT OF SUBSTITUTE GOODS UREMENT OF SUBSTITUTE GOODS IN CONTRACT, STRICT LIABILIT ISING IN ANY NAY GUT OF THE U > BILITY OF SUCH DAMAGE.
38 39 40	**	nclud	Port Get Board Info	Serial ports COM1
41	\$1 \$1	nclud	Programmer: "AVRISP mkll" Burn Bootloader	2 COM6 (Arduino/Genuino Uno)

Figure 11. Arduino IDE Communications Port

3. Upload the sketch from Step 1 to the Arduino board by clicking the right pointing arrow button shown in Figure 12.

SVAL-ADT7420   Arduino 1.8.9 (Windows Store 1.8.21.0)	$\sim$	$\times$
File Edit Sketch Tools Help		
🤣 📀 🛅 🔛 Upload		ø
EVAL-ADT7420		

Figure 12. Arduino IDE Upload Sketch

4. When the uploading process is completed, a message at the bottom of the IDE displays the message in Figure 13.

nneuploading retch uses 9726 bytes (30%) of program storage space. Maximum is 32256 bytes. obal variables use 600 bytes (29%) of dynamic memory, leaving 1448 bytes for local

#### Figure 13. Arduino IDE Upload Success

5. Open the serial monitor by navigating to Tools > Serial Monitor (see Figure 11 for the Tools dropdown list). Select Newline for the dropdown list circled in red in Figure 14 and set the baud rate to 115200. To use the serial monitor, enter the commands in Figure 14 in the text box at the top of the window and click Send.

COM6		×
1		Send
Connection to device succeeded!	 	
* * * * * * * * * * * * * * * * * * * *	 • •	
<ul> <li>EVAL-7420SDZ Demonstration Program</li> </ul>		
* This program demonstrates communication with the ADT7420		
high accuracy digital temperature sensor		
" Set the baud rate to 115200 select the newline terminator		
	 * *	
Command Summary:		
1- Read temperature		
2- Set resolution		
3- Set operation mode		
4- Poll for a bunch of temperatures		
X- Get critical temperature setting		
X- Test & clear Linduino EEPROM		
Enter a command:		
	1174	ASS OF ALL

Figure 14. Arduino IDE Serial Monitor

### **USING AN EXTERNAL ADT7420**

To select the remote ADT7420, close the serial monitor and change the device address to 0x49 in the sketch example (see Figure 15). Verify and upload the sketch to the Arduino board, then wait until the code finishes uploading and the message in Figure 13 is shown. Next, open the serial monitor.

le Edit Sketch Jools Help		
		0
EVAL-ADT7420		
43 finclude <userin< td=""><td>terface.h&gt;</td><td></td></userin<>	terface.h>	
44 finclude <eeprop< td=""><td></td><td></td></eeprop<>		
45 #include <platfo< td=""><td>rm_drivers.h&gt;</td><td></td></platfo<>	rm_drivers.h>	
46 extern "C" (		
47 #include "adt742	0.h"	
48 12		
49		
50 12c init param 1	2c_params =	
51 (		
52 GENERIC_I2C,	// 12c type	
53 0,	// 12c 1d	
54 100000,	// i2c max speed (hz)	
55 0x49	// i2c slave address	
56 );		
57		

Figure 15. Arduino IDE Code Change

Note that the ADT7310, ADT7320, and ADT7410 can also be selected, but this example sketch only considers the ADT7420 and users must modify the code shown in Figure 15 accordingly.

## NOTES

I<sup>2</sup>C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).



#### 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.

#### Legal Terms and Conditions

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer, all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.

©2019 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners. UG21658-0-10/19(0)



www.analog.com

Rev. 0 | Page 6 of 6