

### FEATURES

**On-board and remote temperature sensing**  
**On-board and remote fan control**  
**No calibration necessary**  
**Programmable over/under temperature limits**  
**USB serial interface**  
**Supports SMBus Alert**  
**3 V to 5.5 V supply**  
**16-lead QSOP**

### OVERVIEW

The ADT7470 evaluation board allows the ADT7470 IC to be quickly and easily evaluated using a PC. Using the evaluation board and its accompanying software, the ADT7470 can interface with any PC running Windows® 2000 or higher via its USB port.

The evaluation board allows the input and output functions of the ADT7470 to be exercised without the need for external components. The software allows control and monitoring of the ADT7470 internal registers. The board is set up for the ADT7470 to act as a temperature-sensing hub for the four on-board TMP05 temperature sensors. It also controls the two on-board fans.

### EVALUATION SYSTEM PACKAGE CONTENTS

The evaluation system package contains:

- The data sheet
- The ADT7470 evaluation board
- A USB interface cable
- The evaluation software on CD

### EVALUATION EQUIPMENT

To begin, users only require a PC with the software installed and a USB cable connected. For fan control, a 12 V dc supply is necessary.

### FUNCTIONAL BLOCK DIAGRAM

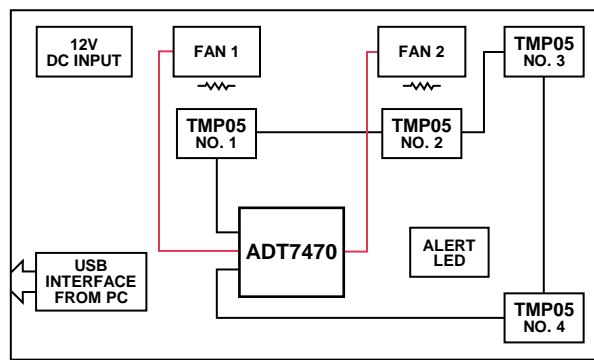


Figure 1.

#### Rev. A

Evaluation boards are only intended for device evaluation and not for production purposes. Evaluation boards as supplied "as is" and without warranties of any kind, express, implied, or statutory including, but not limited to, any implied warranty of merchantability or fitness for a particular purpose. No license is granted by implication or otherwise under any patents or other intellectual property by application or use of evaluation boards. Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Analog Devices reserves the right to change devices or specifications at any time without notice. Trademarks and registered trademarks are the property of their respective owners. Evaluation boards are not authorized to be used in life support devices or systems.

## TABLE OF CONTENTS

Features .....	1	Monitoring of the Temperature and Fan Speed .....	6
Overview.....	1	Changing the Temperature of a TMP05.....	6
Evaluation System Package Contents.....	1	Setting Up the Evaluation Board for Monitoring the On-Board TMP05s.....	6
Evaluation Equipment.....	1	Temperature and Fan Speed Limits and Interrupts.....	7
Functional Block Diagram .....	1	Register Tree/Register Map.....	8
Revision History .....	2	Fan Configuration.....	8
Evaluation Board Hardware.....	3	Saving the Setup .....	8
USB Interface Connector J27 .....	3	Evaluation Board Schematics and Silkscreen .....	9
Getting Started.....	3	Ordering Information.....	15
Evaluation.....	3	Bill of Materials.....	15
Evaluation Board Software .....	4	Ordering Guide .....	16
Installing the Software .....	4	ESD Caution.....	16
Using the Software.....	4		
The ADT7470 Evaluation Software Dialog Box.....	5		

## REVISION HISTORY

### 9/12—Rev. 0 to Rev. A

Changes to Overview Section .....	1
Changes to Ordering Guide .....	16

### 11/06—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

The evaluation board consists of the ADT7470, four TMP05 temperature sensors, two fans, and heating elements. The ADT7470 monitors the temperature of the TMP05s. Up to six more TMP05s can be connected to the board in a daisy-chain fashion via the J15 connector. The ADT7470 also controls the fan speed of both on-board fans. There is provision for control of two more fans that can be easily connected to the board via the J10 connector and J14 connector. This data sheet concentrates on the on-board TMP05s and fans only. There are various test points around the board for ease of evaluation.

The evaluation board also has a USB section. This allows the PC software to communicate with the evaluation board through the USB port of the PC. Users can easily change register settings on the ADT7470 this way and monitor the status registers. The software uses this interface to plot the graphs seen in the graphing section of the software.

### USB INTERFACE CONNECTOR J27

The connections to J27 are shown in Table 1.

Table 1. J27 Connections

J1 Pin	ADT7470 Function
1	5 V
2	SCL
3	SDA
4	GROUND

## GETTING STARTED

Do not connect the USB cable to the evaluation board until the software is installed.

To get started:

1. Install the ADT7470 software. (If installed already, skip this step).
2. Connect the evaluation board to the USB port on the computer, using the USB interface cable provided.
3. Run the software from the Windows Start menu.
4. Connect a 12 V dc supply to J17 or J18.
5. For temperature monitoring of the TMP05s, ensure that Jumper J19 is in Position B.

The evaluation board is now ready to use. Everything is controlled by the software; it is recommended to use the software for changing settings and monitoring their effects on the system.

## EVALUATION

The ADT7470 performs many temperature sensing and fan control functions. The evaluation board allows users to simulate various faults that could affect the ADT7470 in a working system. Users can monitor how the ADT7470 handles these events in many ways. See the Evaluation Board Software section for a description of the software. The board's Alert LED can also show certain fault conditions.

## EVALUATION BOARD SOFTWARE

The software allows the ADT7470's functions to be controlled from the PC via an easy to use interface operating under the Windows environment. The contents of the device's internal registers can easily be read or altered through a user-friendly graphical interface.

### INSTALLING THE SOFTWARE

To install the software:

- Insert CD into the CD drive and select it.
- Click ADT7470 Evaluation Software. The InstallShield Wizard dialog box will then appear.
- Follow the on-screen instructions to complete the installation.

To use the software immediately, the user must select the Yes option to restart his or her PCs so that Windows can update the setup files. If the user does not wish to use the software immediately, he or she must select the No option. No matter which option is selected, the user must click Finish to complete the installation.

### USING THE SOFTWARE

When using the software, first ensure that the evaluation board is connected to the PC. To start the software, click Start/Programs/Analog Devices/ADT7470 Evaluation Software. The loading dialog box in Figure 2 will then appear. If the board is not plugged in, the user will get an error message, and the software will not start.



Figure 2. Software Loading Dialog Box

**ADT7470 EVALUATION SOFTWARE DIALOG BOX**

The ADT7470 Evaluation Software dialog box (see Figure 3) controls the settings for the ADT7470 and allows the user to communicate easily with the evaluation board. By using the pull down menus and toolbar icons, the user can access the various settings and readings. The associated dialog box will appear as a subbox in the ADT7470 Evaluation Software dialog box.

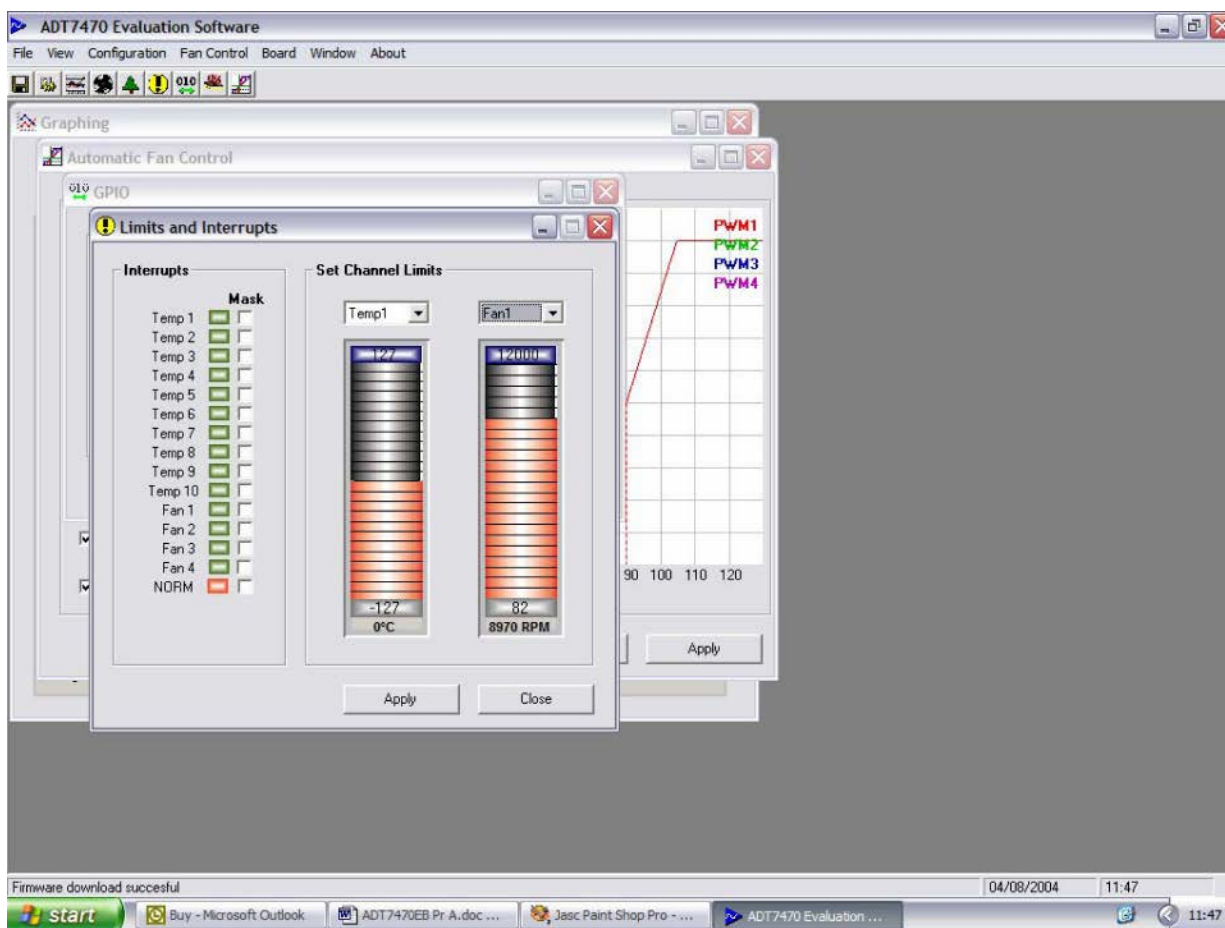


Figure 3. ADT7470 Evaluation Software Dialog Box

## MONITORING OF THE TEMPERATURE AND FAN SPEED

Click View/Graphing in the ADT7470 Evaluation Software dialog box. A dialog box will appear that shows a real-time graph of the temperature of the four TMP05s as well as a graph of the fan speed of both fans (see Figure 4). The graph can be resized by grabbing and dragging the tabs on the y-axis of the graphs. A change in any of the TMP05s or the fans will be seen here.

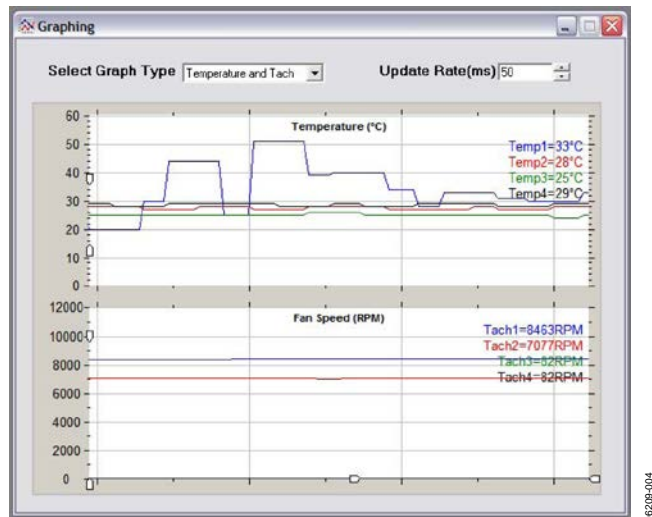


Figure 4. Graphing Dialog Box

## CHANGING THE TEMPERATURE OF A TMP05

Two heating elements are built-in to the board, which allows users to heat up either TMP05 No. 1 or TMP05 No. 2. The software can be used to perform this. Click Board/On Board Heater Control in the ADT7470 Evaluation Software dialog box (or click the Heater Control icon). This opens a simple interface that allows users to heat up a resistor on the evaluation board. Figure 6 shows a screen shot of the Heater Control dialog box and the Graphing dialog box. As is shown in Figure 6, TMP05 No. 1 was heated up because of the on-board heater. If automatic fan speed control is enabled, Fan No. 1 will increase its speed to try to compensate for the increased temperature.

## SETTING UP THE EVALUATION BOARD FOR MONITORING THE ON-BOARD TMP05s

Click the Configuration/General Configuration in the ADT7470 Evaluation Software dialog box. The Configuration dialog box will appear (see Figure 5), which shows some general configuration items. Note that it is necessary to change the Pin13 Setup to TMP05 Start Output to ensure that the ADT7470 monitors the TMP05s on the board.

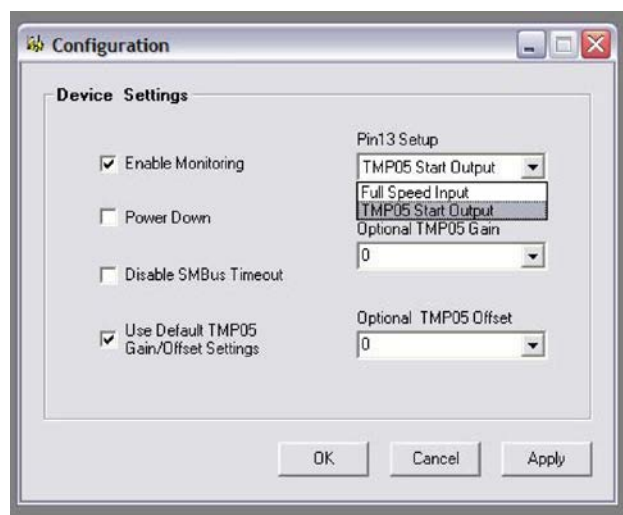


Figure 5. Configuration Dialog Box

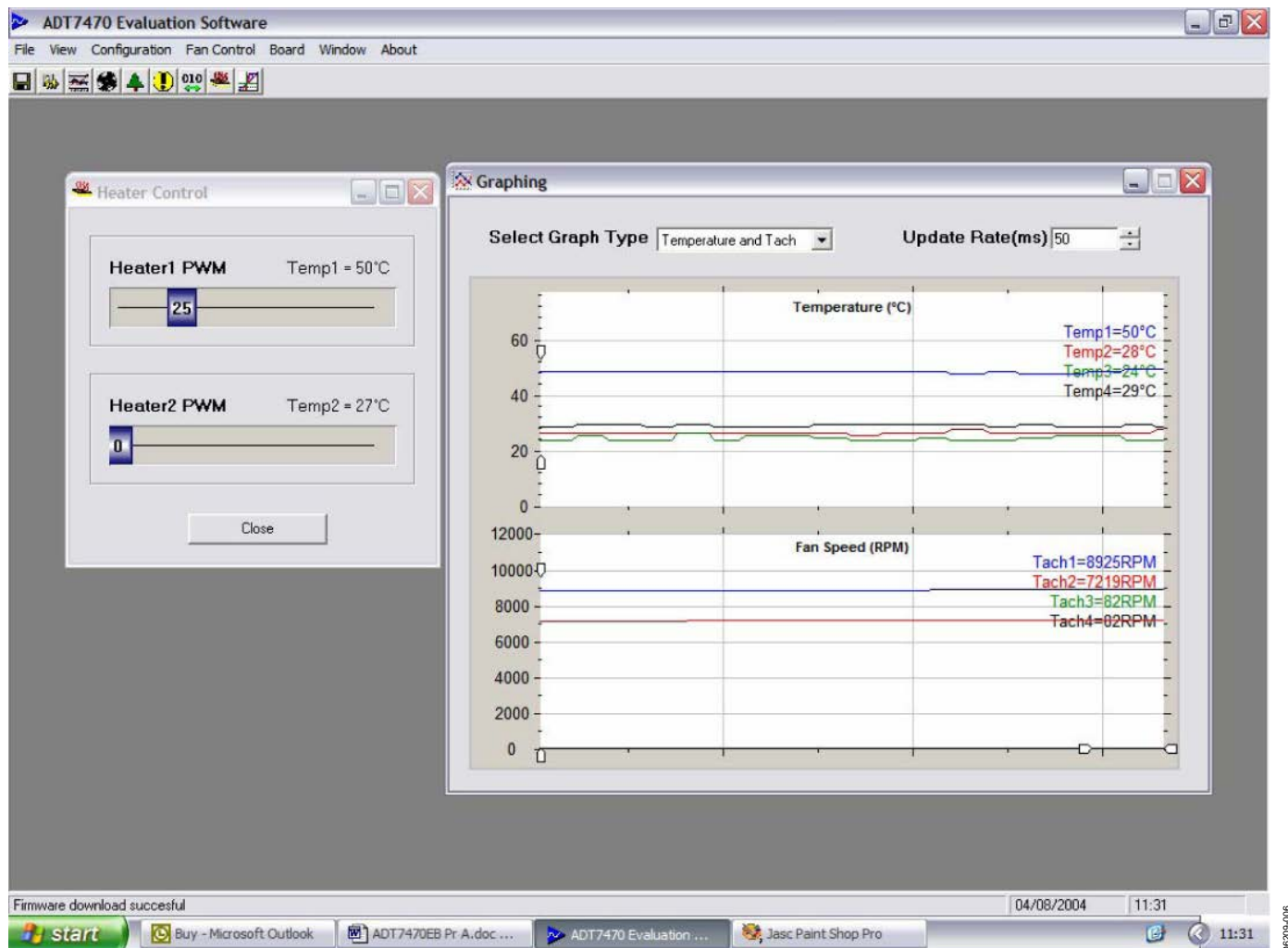


Figure 6. Heater Control and Graphing Dialog Boxes

## TEMPERATURE AND FAN SPEED LIMITS AND INTERRUPTS

Click View/Limits and Interrupts in the ADT7470 Evaluation Software dialog box. The Limits and Interrupts dialog box will then appear and display a slider bar for the temperature and fan speed limits. Users can click the drop-down box to set each of the temperature and fan speeds. If any limits are exceeded, the associated Interrupts icon on the left side of the dialog box will turn from green to orange. In Figure 7, Fan 2 has exceeded one of its limits, so its Interrupts is orange. To mask (ignore) this interrupt flag, the user should click the Mask button associated with the interrupt. When an interrupt is set, the red Alert LED on the evaluation board is also set. If the error condition is removed, it will turn off.

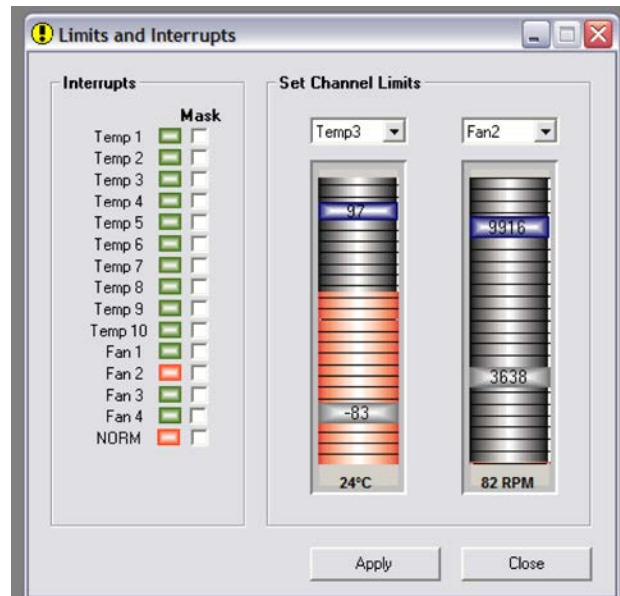


Figure 7. Limits and Interrupts Dialog Box

REGISTER TREE/REGISTER MAP

Another alternative to the software programming mentioned so far is to program the bits in each register individually. This is where the Register Map dialog box can be used. Click View/ Register Map in the ADT7470 Evaluation Software dialog box to access this (see Figure 8). Users can choose an individual register by expanding the tree and by clicking on the appropriate register. The contents of the register can be changed in two ways. Users can click the bit in the bit display or type in a Hex or Dec value and write to the register. Note that it is not possible to write a new value to a read-only register. Users should crossreference the ADT7470 data sheet when using the Register Map dialog box because it contains additional information and a description of the bit functions. In general, users should not use this dialog box unless they are very familiar with this part.

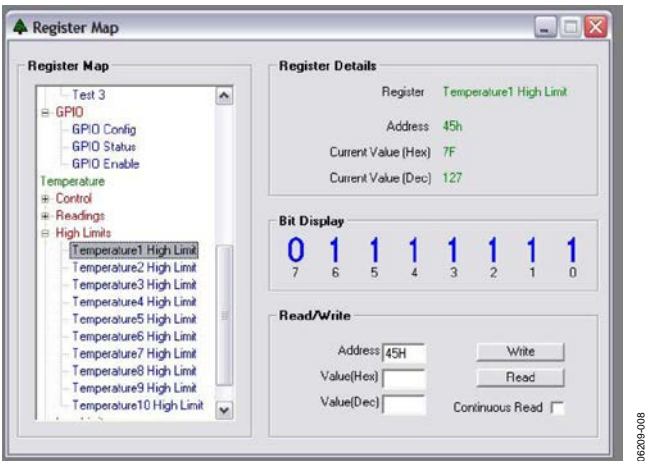


Figure 8. Register Map Dialog Box

FAN CONFIGURATION

Another way to set up the fans is to open the Fan Configuration dialog box. Click Configuration/Fan Configuration in the ADT7470 Evaluation Software dialog box (see Figure 9). In this dialog box, users can configure each fan, individually or collectively, by clicking on the appropriate tab.

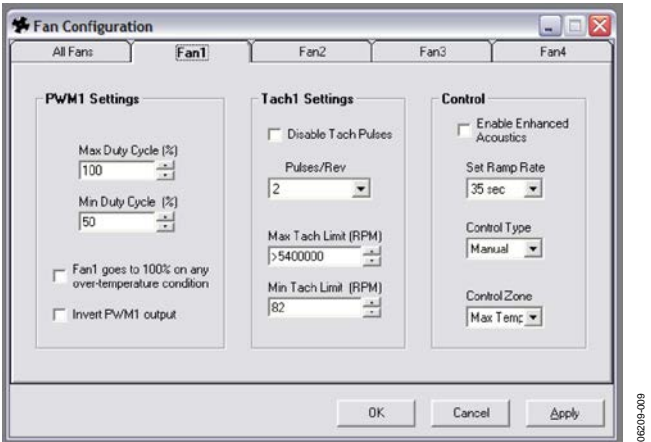


Figure 9. Fan Configuration Dialog Box

SAVING THE SETUP

To save the settings of the ADT7470 software, click File/Save/Recall Configuration in the ADT7470 Evaluation Software dialog box. This allows users to save the contents of the registers and the current evaluation board setup to a file. This file can be shared with a colleague, customer, or vendor to help recreate the desired setup. To open an existing file, click File/Save/Recall Configuration in the ADT7470 Evaluation Software dialog box and choose the appropriate data file.



## EVALUATION BOARD SCHEMATICS AND SILKSCREEN

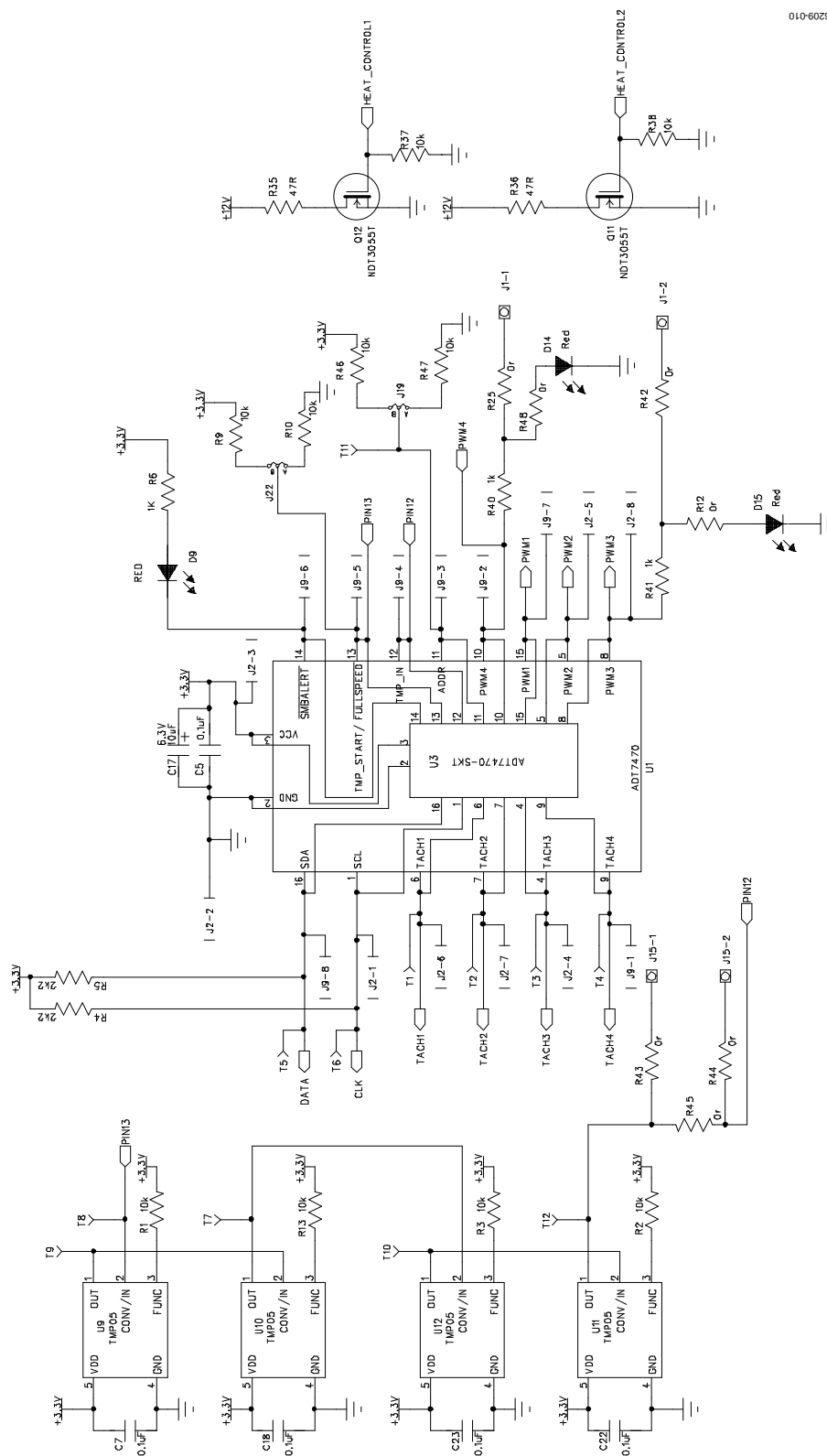
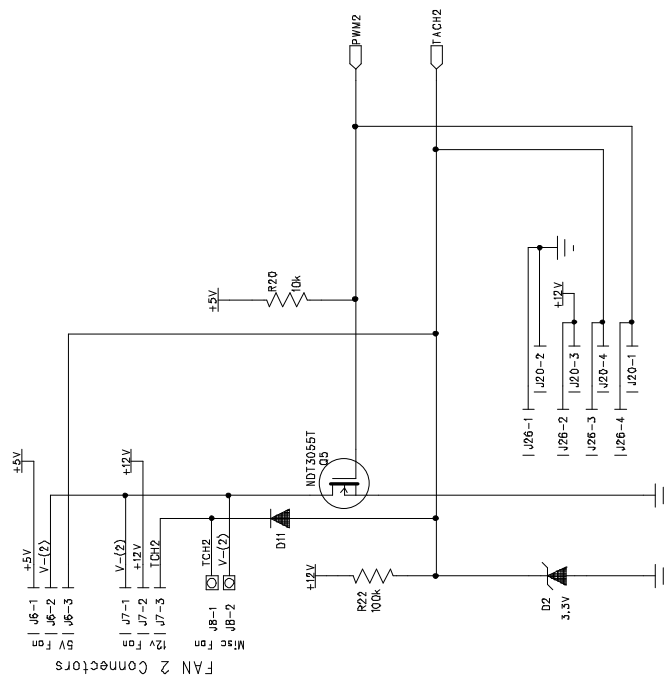


Figure 10. ADT7470 Evaluation Board Schematic



## FAN 1 Drive Circuitry

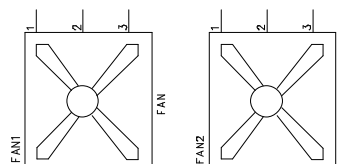
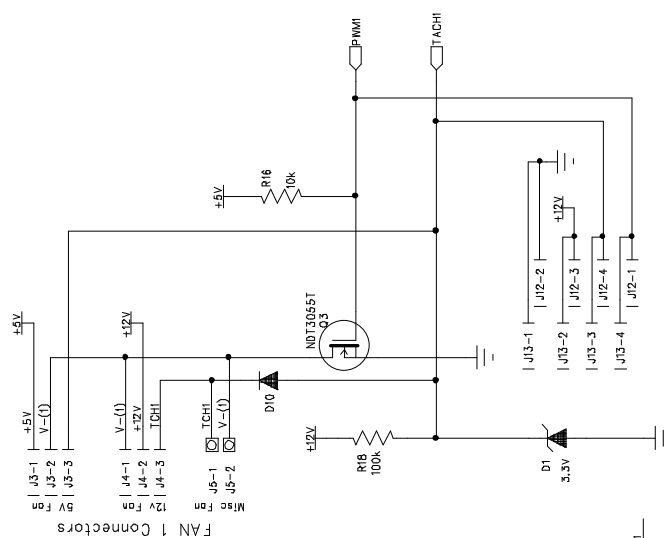


Figure 11. ADT7470 Evaluation Board Schematic

## FAN 3 Drive Circuitry

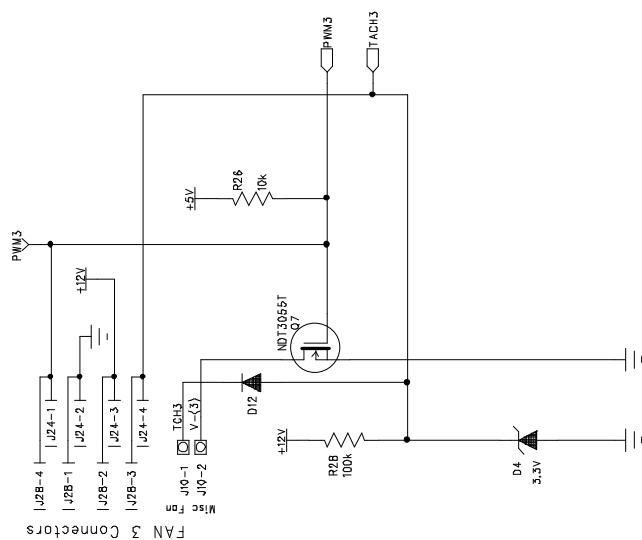


Figure 12. ADT7470 Evaluation Board Schematic

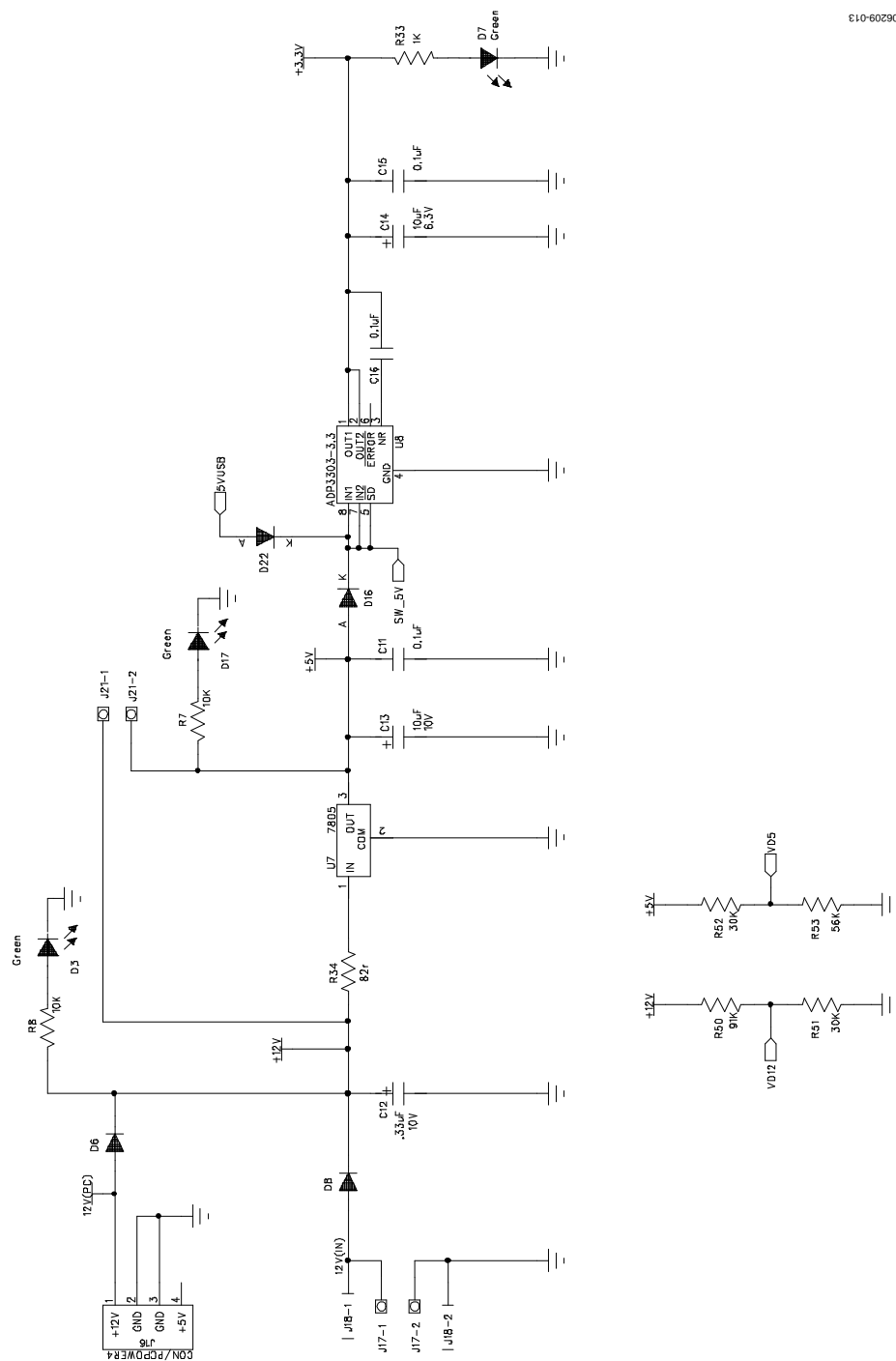


Figure 13. ADT7470 Evaluation Board Schematic

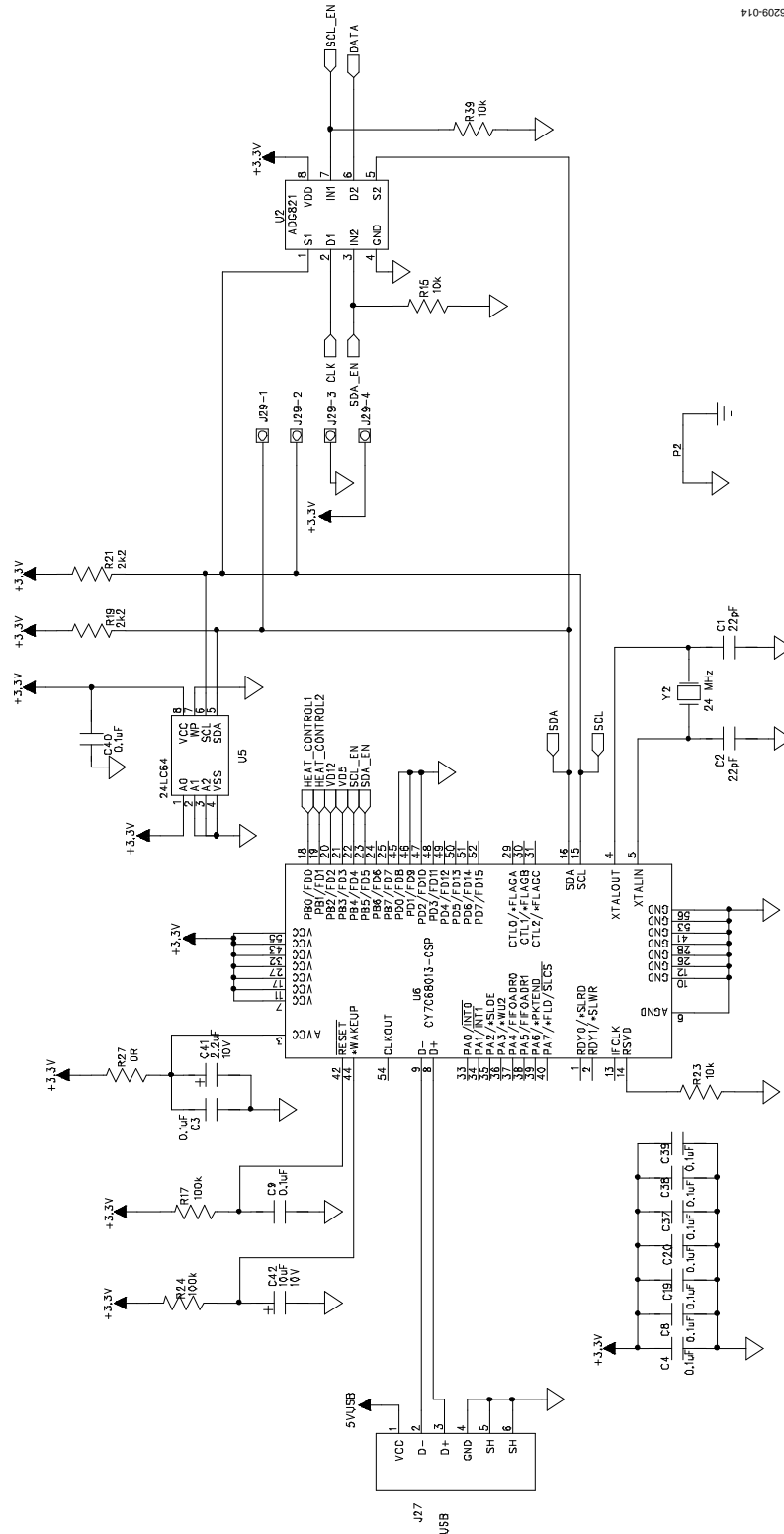


Figure 14. ADT7470 Evaluation Board Schematic

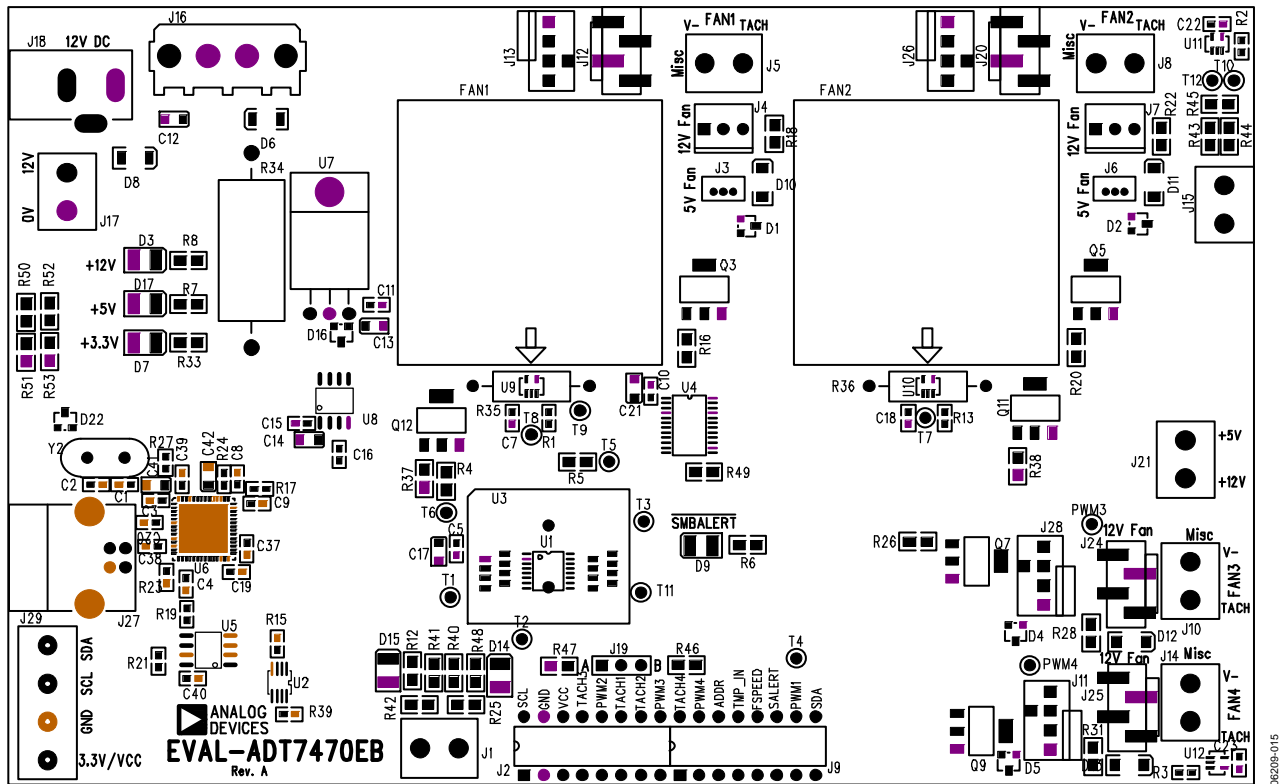


Figure 15. ADT7470 Evaluation Board Silkscreen

## ORDERING INFORMATION

## BILL OF MATERIALS

Table 2.

Reference Designator	Description	Value	Package	Supplier/No.
C1, C2	SMD ceramic capacitor	22 pF	603	FEC 722-005
C3 to C5, C7 to C9, C11, C15, C16, C18 to C20, C22, C23, C37 to C40	SMD ceramic capacitor	0.1 $\mu$ F	603	FEC 317-287
C12	35 V tantalum capacitor+	0.33 $\mu$ F	CAP\TAJ_A	FEC 498-919
C13, C14, C17, C42	10 V tantalum capacitor+	10 $\mu$ F	CAP\TAJ_A	FEC 197-130
C41	10 V tantalum capacitor+	2.2 $\mu$ F	CAP\TAJ_A	FEC 9753796
D1, D2, D4, D5	3.3 V Zener diode	3 V	SOT23	FEC 1081419
D3, D7, D17	Green LED		LED_CHIP	FEC 10211331
D6, D8	DIODE-PRLL4001, rectifier diode passivated 1 A, 50 V SMD MELF			Digi-Key DL4001-TPMSCT-ND
D9, D14, D15	Red LED		LED_CHIP	FEC 1212753
D10 to D13	Schottky diode		MELF3	FEC 9804234
D16	Schottky diode-SOT23 (not inserted)		SOT23	N/A
D22	Schottky diode-SOT23		SOT23	FEC 9526765
FAN1, FAN2	FAN 5 VDC, 145 mA, 34.5 mm, MPU flat		FAN_PANASONIC_SMALL	Digi-Key P9697-ND
J1, J5, J8, J10, J14, J15, J17, J21	2-way (5 mm) terminal block		CON\POWER	FEC 9632972
J2, J9	HEAD8_SIDE_ENTRY, side entry socket (x2 8-way sockets)		DIP16	FEC 799-2165 (x2)
J3, J6	HEADER03-FAN, 3-pin header, 1.25 mm vertical		SIP-3P-1.25MM	FEC 9732853
J4, J7	HEADER03-FAN, 3-pin header, 0.1 inch vertical		SIP-3P-POL	FEC 5223740
J11, J13, J26, J28	CON-SIP-4P_FAN_CONN, 4-pin thru hole fan connector		SIP-4P_FAN_CONN	Molex 47053-1000
J12, J20, J24, J25	CON-SIP-4P_SMD_FAN_CONN, 4-pin header, 0.1 inch vertical SMD		SIP-4P_SMD_FAN_CONN	Digi-Key WM7204-ND
J16	CON/PCPOWER4, 4-way shrouded header		CON\PCPOWER4	FEC 148-086
J18	CON-BARREL, 2.1 mm dc connector		CON\BARREL	FEC 224-959
J19, J22	JUMPER2\SIP3. 3-pin SIL header and shunt		LINK-3P	FEC 1022249, FEC 150-411
J27	USB-B socket		USB_RECPTACLE_B	FEC 1097897
J29	CON\POWER4, 4-way (5 mm) terminal block		CON\POWER4	FEC 9632972 (x2)
Q3, Q5, Q7, Q9, Q11, Q12	NDT3055T, mosfet, N SOT-223		SOT223	FEC 9845305
R1 to R3, R11, R13, R15, R23, R39	SMD resistor 1%	10 k $\Omega$	603	FEC 933-0399
R4, R5	SMD resistor	2.2 k $\Omega$	805	FEC 933-2812
R6, R33, R40, R41	SMD resistor	1 k $\Omega$	805	FEC 933-2383
R7 to R10, R16, R20, R26, R37, R38, R46, R47	SMD resistor	10 k $\Omega$	805	FEC 933-2391
R12, R25, R42 to R45, R48	SMD resistor, 1%	0 $\Omega$	805	FEC 933-1662
R17, R24	SMD resistor, 1%	100 k $\Omega$	603	FEC 933-0402
R18, R22, R28, R31	SMD resistor	100 k $\Omega$	805	FEC 933-2405
R19, R21	SMD resistor, 1%	2.2 k $\Omega$	603	FEC 933-0810
R27	SMD resistor, 1%	0 $\Omega$	603	FEC 933-1662
R34	RES-2W, Wire Link	82 $\Omega$	R2W	Wire Link
R35, R36	RES-1/2W, resistor, PRO2, 5%, 47 $\Omega$ , 2W	47 $\Omega$	R1/2W	FEC 9475346
R50	SMD resistor	91 k $\Omega$	805	FEC 933-3649
R51, R52	SMD resistor	30 k $\Omega$	805	FEC 933-3002

Reference Designator	Description	Value	Package	Supplier/No.
R53	SMD resistor, 1%	56 k $\Omega$	805	FEC 933-3380
T1 to T12	Test point, red PCB terminal		TESTPOINT	FEC 8731144
U1	ADT7470, temperature sensor and fan controller		QSOP-16	ADT7470ARQZ
U2	ADG821, dual SPST switch		MS08	ADG821BRMZ
U3	ADT7470-SKT, 16-pin QSOP socket, not inserted		QSOP16-SKT	Enplas OTS-16 (28)-0.635-02
U5	24LC64, 64K serial EEPROM		SO8NB	FEC 9758070
U6	CY7C68013-CSP, USB controller IC		CSP-56	Digi-Key CY7C68013A-56LFC
U7	7805, 5 V regulator		TO-220	FEC 9666095
U8	ADP3303-3.3, 3.3 V regulator		SO8NB	ADP3303ARZ-3.3
U9 to U12	TMP05, temperature monitor		SC70_5LD	TMP05AKSZ
Y2	XTAL1, crystal, 24.000000 MHz	24 MHz	HC49	FEC 9509640

## ORDERING GUIDE

Model <sup>1</sup>	Package Description
EVAL-ADT7470EBZ	Evaluation Board

<sup>1</sup> Z = RoHS Compliant Part.

## 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.