Evaluation Kit for AD7156
Ultralow Power Capacitance Converter

EVAL-AD7156

GENERAL DESCRIPTION

This data sheet describes the AD7156 evaluation board and PC software.

Additional details about the AD7156, an ultralow power, 2-channel capacitance-to-digital converter (CDC) are available in the AD7156 data sheet, which should be consulted in conjunction with this data sheet when using the EVAL-AD7156.

More information about the Analog Devices, Inc., family of CDC products can be found at www.analog.com/CDC.

EVALUATION BOARD DESCRIPTION

The AD7156 evaluation kit is a powerful tool for exploring and evaluating the AD7156 features at many different levels.

The board is connected to a PC via a standard USB interface. The PC software allows the graphical display of real-time data, modification of the AD7156 internal settings, and generally assists in understanding the part features and performance.

The flexible interface structure of the evaluation board allows it to be connected in several useful configurations. For example, the digital section of the evaluation board can be used independently as a convenient digital interface for a user's own sensor design PCB or as a module containing the AD7156. Alternatively, an external microcontroller can be interfaced to the AD7156. Thus, the evaluation board can act as a complete analog front end for creating and debugging software on the user's own digital platform.

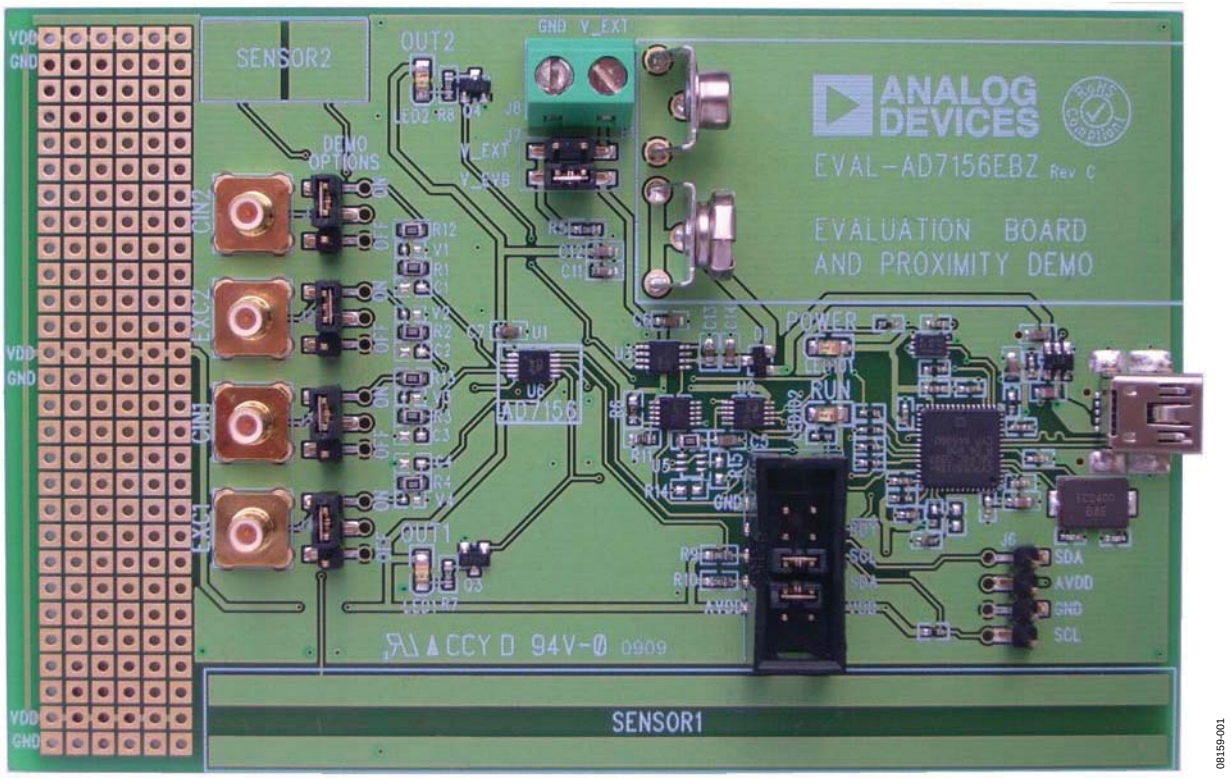

Figure 1. AD7156 Evaluation Board

Rev. 0

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REVISION HISTORY

6/09—Revision 0: Initial Version

EVALUATION SOFTWARE INSTALLATION

Install the AD7156 evaluation board software before connecting the AD7156 evaluation board to the PC. To do so, complete the following steps:

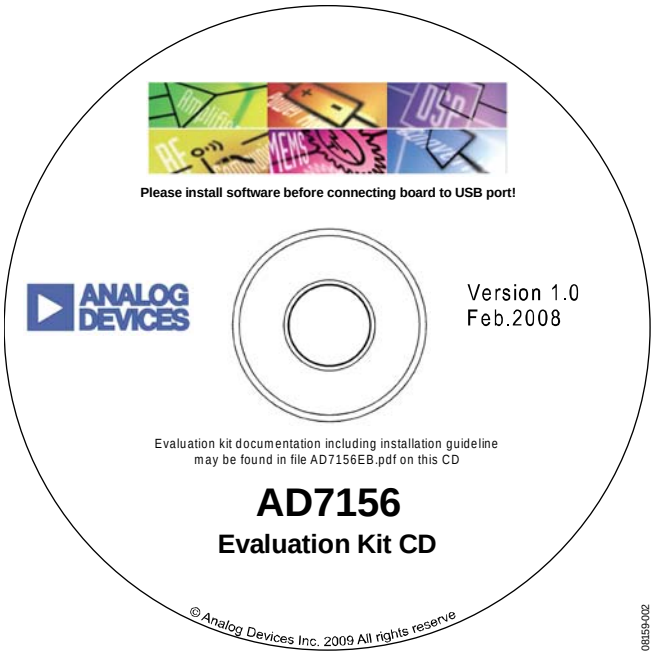

Figure 2. AD7156 Evaluation Kit CD

1. Insert the AD7156 evaluation kit CD in the CD-ROM drive of your PC. The evaluation software installation wizard should start automatically. If the wizard does not start, run **Setup.exe** from the AD7156 evaluation kit CD.

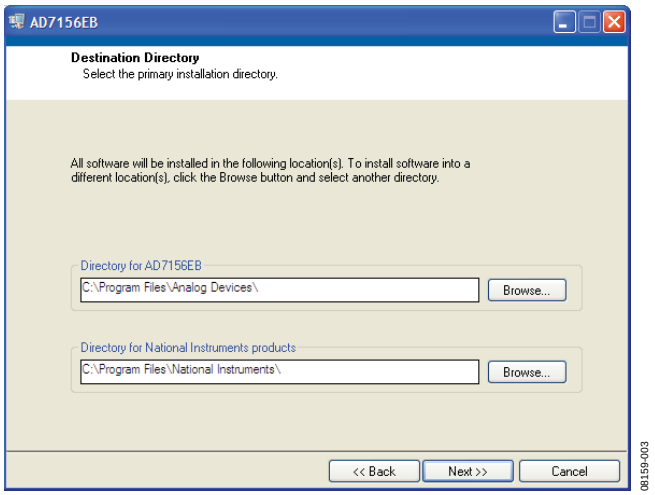

Figure 3. AD7156 Evaluation Software Installation

2. Follow the steps in the evaluation software installation wizard until the installation is completed.
3. Connect the AD7156 evaluation board to your PC USB connector using the USB cable included in the evaluation kit. The **POWER** LED on the evaluation board turns on and the **Found New Hardware Wizard** starts automatically on the PC.

Figure 4. Found New Hardware Wizard

4. Follow the steps in the **Found New Hardware Wizard** window. If a message that the software has not passed Windows® Logo testing appears, click **Continue Anyway**.

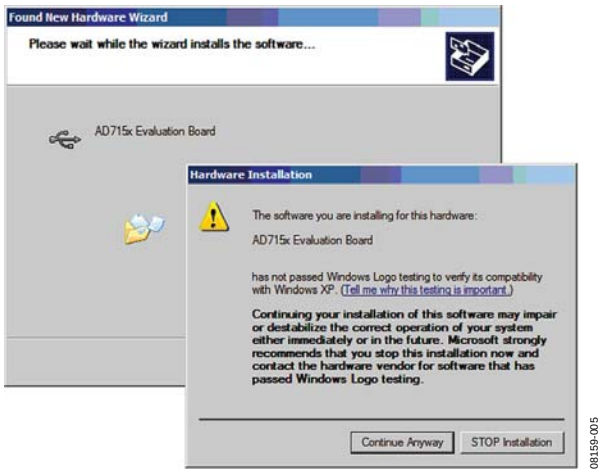

Figure 5. Windows Logo Warning

5. Follow the steps in the **Found New Hardware Wizard** window until the installation is completed.

EVALUATION BOARD HARDWARE

POWER SUPPLY

To use the AD7156 evaluation board, make sure that the link on the supply header (J7) is in place, either in V_EVB when using the on-board voltage supply or in V_EXT when using an external voltage source via J8.

In both cases, the LED labeled **POWER** on the board should turn on when connected to either of the supply sources.

I²C INTERFACE CONFIGURATION OPTIONS

The AD7156 evaluation board allows different digital interface configurations by redirecting the I²C® signals, SDA and SCL, on J5.

Default

Links in the SDA and SCL positions of J5 connect the USB microcontroller as the I²C bus master to the on-board AD7156, as shown in Figure 6. This allows easy use of the evaluation board together with the PC software.

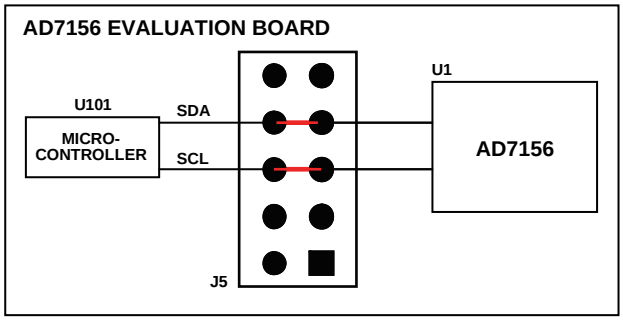

Figure 6. AD7156 Evaluation Board in Default Configuration

USB—External Connection

The AD7156 evaluation board allows customers to connect their own specific AD7156 application board to Pin 6 and Pin 8 of J5. This enables customers, together with the PC evaluation software, to evaluate their application hardware using the AD7156 evaluation board only as a USB-to-I2C digital interface as shown in Figure 7.

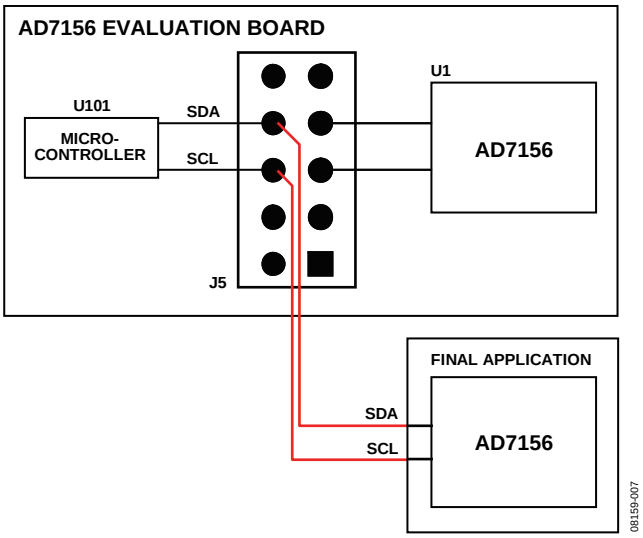

Figure 7. AD7156 Evaluation Board as USB-to-I²C interface

External Connection—AD7156

The AD7156 evaluation board can be used for software development by connecting a customer-specific external microcontroller board to Pin 5 and Pin 7 of J5, as shown in Figure 8, using the AD7156 CDC on the evaluation board as the sensing device.

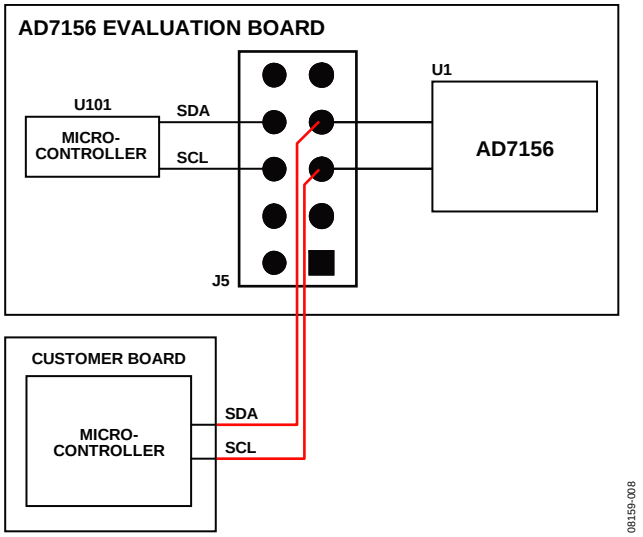

Figure 8. AD7156 Evaluation Board Software Development Platform

EVALUATION BOARD SOFTWARE

STARTING THE EVALUATION SOFTWARE

Start the AD7156 evaluation software on the PC.

Click the **Start** button, located at the bottom left-hand corner of your desktop. Select **Programs**, then **Analog Devices**, then **AD7156 Evaluation Software**, and then **AD7156EB** to run the software.

If a connection between the software and the evaluation board is correctly established, the window shown in Figure 9 appears. The USB indicator in the top right corner of the software window turns on green, and the LED labeled **RUN** on the AD7156 evaluation board flashes in approximately 1 sec intervals.

DATA ACQUISITION WINDOW

Reset

When **Reset** is clicked, the software accesses AD7156 Register Address 0xBF to reset the part. See the AD7156 data sheet for details on the serial interface.

Demo Setup

Clicking on **Demo Setup** configures the AD7156 to its default settings, as shown in Figure 10.

Setup

Click **Setup** to open the AD7156 setup window (see Figure 10), which provides access to the AD7156 settings.

Log Data to File

When **Log data to file** is clicked, the software allows you to log the acquisition data into a text file with the ASCII tab character as the delimiter to allow easy import to a data processing tool, such as Microsoft® Excel.

Start Acquisition

Clicking the green **Start Acquisition** button in the AD7156 evaluation software window starts the data acquisition. The LED labeled **RUN** on the evaluation board turns on, the **RUN** indicator in the top right corner of the software window turns on red, and graphs in the software start displaying the measured data.

The data displays and the traces in the graphs represent real-time data read from the AD7156.

Graphs

The graphs show the history of data of up to 65,536 samples. You can modify the graph appearance. For example, the scale can be modified by typing minimum and maximum numbers when the autoscale is turned off. Place the cursor on the graph and right-click the mouse to open the graph submenu, which allows different individual graph settings.

When **Clear Graphs** is clicked, the graph and the graph history are cleared.

Data Format and Units

Both displays show the data as hexadecimal codes read from the AD7156 and translated to picofarads (pF). The graphs can show the data in either hexadecimal codes or translated in picofarads. To switch between these two modes, click **Display pF**. The **Display pF** button switches to **Display Code** when clicked.

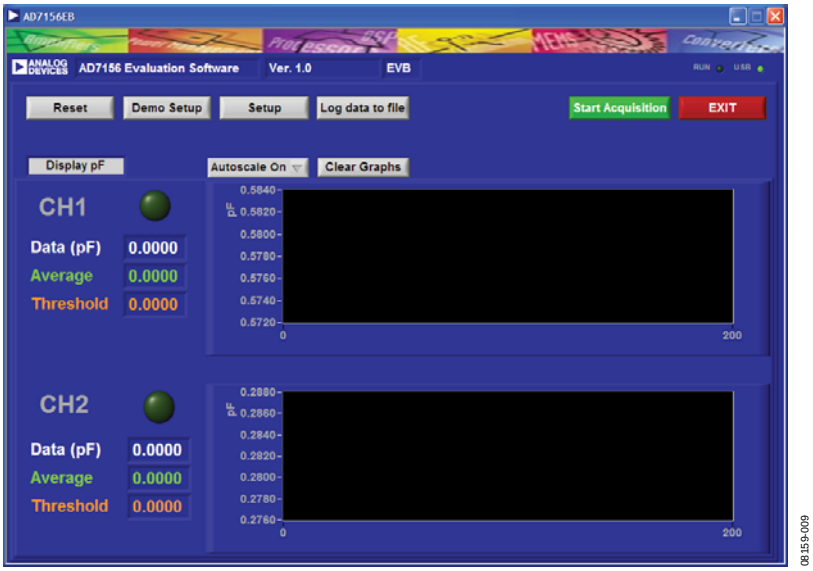

Figure 9. AD7156 Evaluation Software Data Acquisition Window

SETUP WINDOW

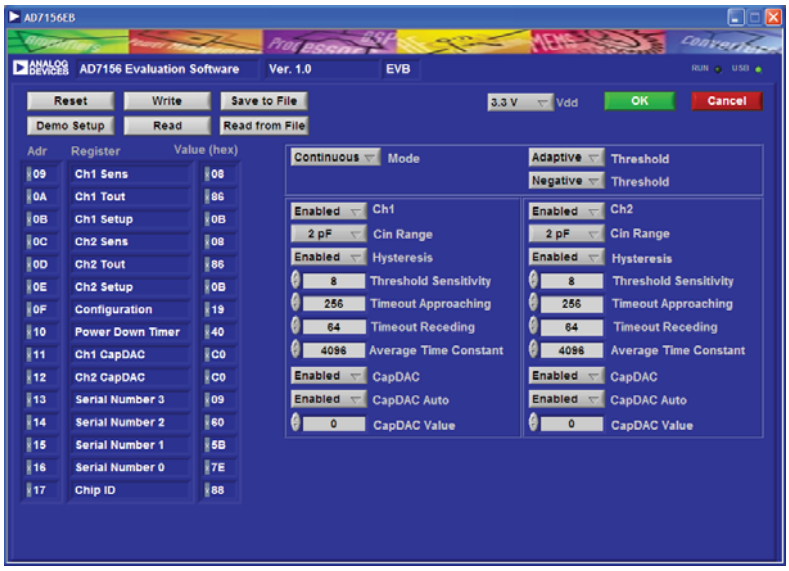

Figure 10. AD7156 Evaluation Software Setup Window

Register Field

The register section of the setup window (left portion of the window) indicates the address, register name, and the current content in hexadecimal form for each AD7156 register.

Reset

When **Reset** is clicked, the software accesses AD7156 Register Address 0xBF to reset the part. See the AD7156 data sheet for details on the serial interface.

Demo Setup

A click on **Demo Setup** configures the AD7156 to its default settings as shown in Figure 10.

Write

When **Write** is clicked, the evaluation software writes the current settings shown in the setup window into the AD7156 registers.

Read

When **Read** is clicked, the evaluation software reads the current register content of the AD7156 registers and the updates are shown in the setup window.

Save to File

When **Save to File** is clicked, a window opens to allow the current settings to be saved to a text file.

Read from File

When **Read from File** is clicked, a window opens to allow you to read back previously saved settings from a text file.

Vdd

The **Vdd** box allows you to set the supply voltage for AD7156 within its specified limits between 1.8 V and 3.6 V. The default setting for the supply voltage is 3.3 V.

OK

When **OK** is clicked, the evaluation software writes the current settings into the AD7156 registers, the setup window closes, and the software returns to the data acquisition window.

Cancel

When **Cancel** is clicked, the evaluation software writes the register settings that were buffered from the time the setup window was opened into the AD7156 registers. The setup window then closes and the software returns to the data acquisition window.

MODE OF OPERATION

Mode

The **Mode** box allows you to put the AD7156 into the following operating modes:

- Standby mode (idle).
  The part is fully powered up, but not performing any conversion.
- Continuous conversion.
  The part is repeatedly performing conversions on the enabled channel(s). If two channels are enabled, the part is sequentially switching between them.
- Single conversion.
  The part performs a single conversion on the enabled channel. If two channels are enabled, the part performs two conversions, one on each channel. After finishing the conversions, the part goes to standby mode (idle).
- Power-down.
  Powers down the on-chip circuits, except the digital interface.

Threshold Modes

The upper **Threshold** box allows you to set the AD7156 threshold to either adaptive or to fixed see Figure 17.

When the upper mode box is set to adaptive mode, the lower **Threshold** box allows you to define the threshold level to be positive, negative, in-window, or out-window see Figure 17.

Adaptive Mode

In adaptive mode, the thresholds are dynamically adjusted, ensuring indication of fast changes (for example, an object moving close to a capacitive proximity sensor) and eliminating slow changes in the input (sensor) capacitance, usually caused by environment changes such as humidity or temperature.

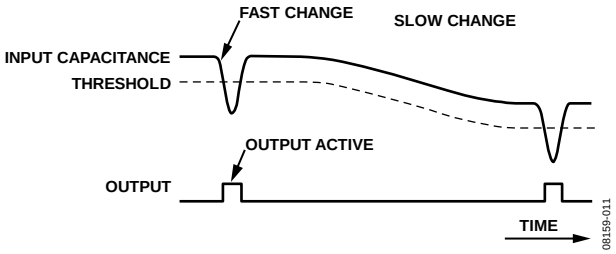

Figure 11. Adaptive Threshold Indicates Fast Changes and Eliminates Slow Changes in Input Capacitance

Fixed Mode

In fixed mode, the threshold is fixed to a defined value, and changes in the input capacitance are indicated when the input data crosses the fixed threshold.

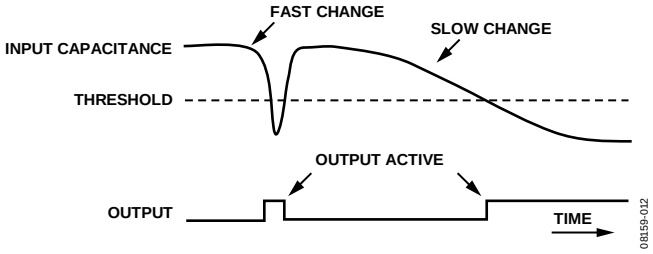

Figure 12. AD7156 in Fixed Mode

Negative Threshold

The negative threshold is set below the average, used when a negative change on the capacitive input is expected. The change on the input is indicated when the input data goes below the threshold.

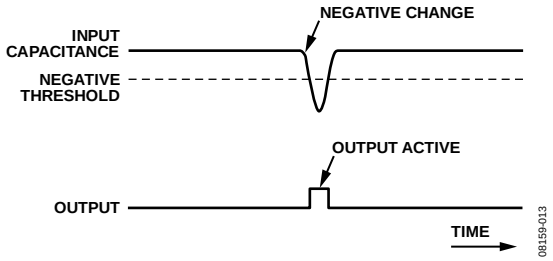

Figure 13. Negative Threshold Mode Indicates Negative Change in Input Capacitance

Positive Threshold

The positive threshold is set above the average, used when a positive change on the capacitive input is expected. The change on the input is indicated when the input data goes above the threshold.

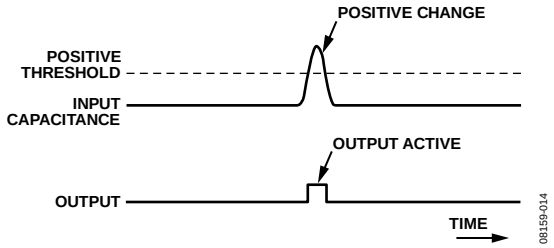

Figure 14. Positive Threshold Mode Indicates Positive Change in Input Capacitance

In-Window Threshold

The in-window threshold has two thresholds, one above and one below the average. The output stays high as long as the input data stays inside threshold window. A change on the input is indicated by a low on the output when the input data goes either above the positive threshold or below the negative threshold.

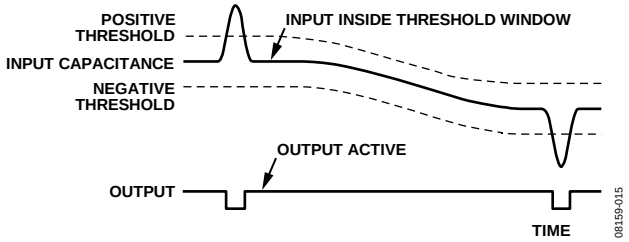

Figure 15. In-Window (Adaptive) Threshold Mode

Out-Window Threshold

The out-window threshold has two thresholds, one above and one below the average. A change on the input is indicated when the input data goes either above the positive threshold or below the negative threshold.

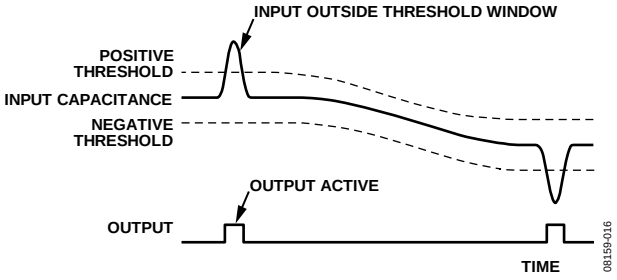

Figure 16. Out-Window (Adaptive) Threshold Mode

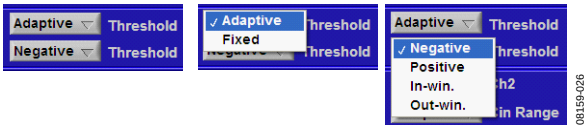

Figure 17. Threshold Mode Select Options

CAPACITIVE INPUT SETTINGS

The AD7156 has two capacitive input channels that can be set up independently via the I²C-compatible interface. These AD7156 settings are described in the following sections and are valid for both channels.

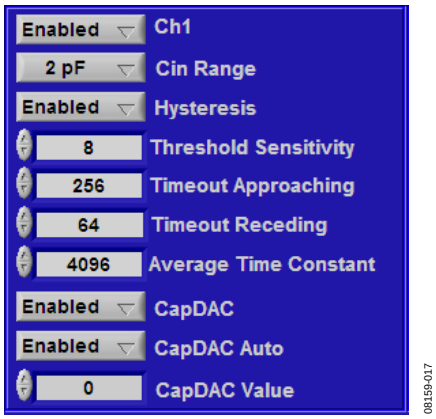

Figure 18. AD7156 Capacitive Input Setup

Ch1, Ch2

The **Ch1** and **Ch2** boxes allow you to enable or disable the capacitive input channels individually.

Cin Range

The **Cin Range** box allows you to select the following capacitive input ranges for each channel: 4 pF, 2 pF, 1 pF, or 0.5 pF.

Hysteresis

The **Hysteresis** box allows you to enable or disable threshold hysteresis when operating in adaptive mode. The hysteresis is fixed to ±¼ of the threshold sensitivity and can be programmed on or off.

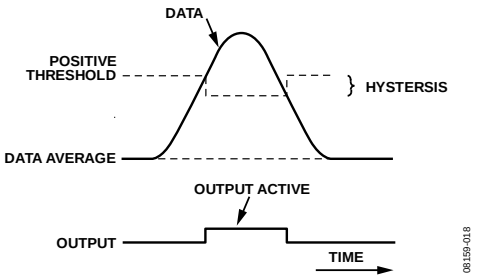

Figure 19. Threshold Hysteresis

Threshold Sensitivity

The **Threshold Sensitivity** box allows you to set a defined sensitivity. This is defined as the distance between the data average and the threshold in codes, as a fixed portion in the range of the lower eight bits out of the 12-bit CDC full-scale range of 0xA000 codes (d40944). Therefore, it represents a different capacitive input value for each capacitive input range.

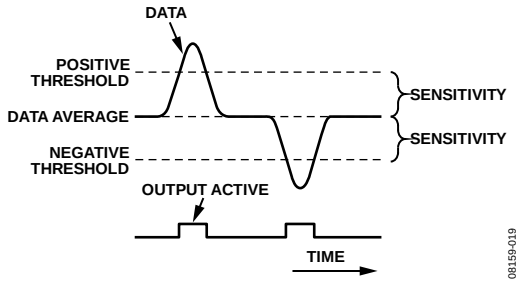

Figure 20. Threshold Sensitivity

Timeout Approaching, Timeout Receding

The **Timeout Approaching** box and **Timeout Receding** box allow you to set a time after which the adaptive average and the threshold adapt to a fast and seemingly permanent change in input capacitance to ensure normal operation after the event.

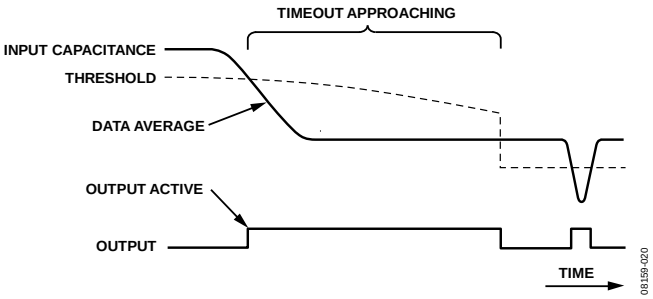

Figure 21. Approaching Timeout in Negative Threshold Mode Shortens False Output Trigger

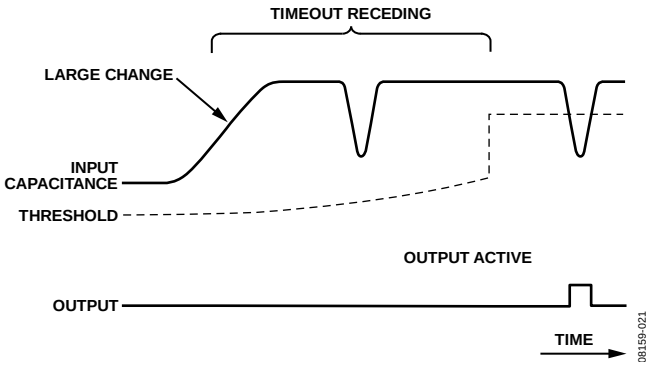

Figure 22. Receding Timeout in Negative Threshold Mode Shortens Period of Missing Output Trigger

The number of conversion cycles, N_C, required for the timeouts to elapse can be calculated using the following equation:

$$N_C = Roundup\left(\frac{2^{16}-1}{2^{15-P+1}-1}\right) \text{ with P value of register nibble}$$

Average Time Constant

The **Average Time Constant** box allows you to determine how fast the moving average adjusts to changes of the capacitive input data. The adaptive threshold algorithm is based on an average calculated from the previous CDC output data, using the following equation:

$$Average(N) = Average(N-1) + \frac{Data(N) - Average(N-1)}{2^{ThrSettling+1}}$$

CapDAC

The **CapDAC** box allows you to enable the CAPDACs that compensate for capacitive offsets on the input (nonchanging).

The **CapDAC Auto** box enables the autoDAC function, which ensures that the data input stays within 25% to 75% of the selected capacitive input range.

The **CapDAC Value** box contains the current CAPDAC value set by the autoDAC. It also allows you to set the value when the autoDAC function is disabled.

EVALUATION BOARD SCHEMATIC AND ARTWORK

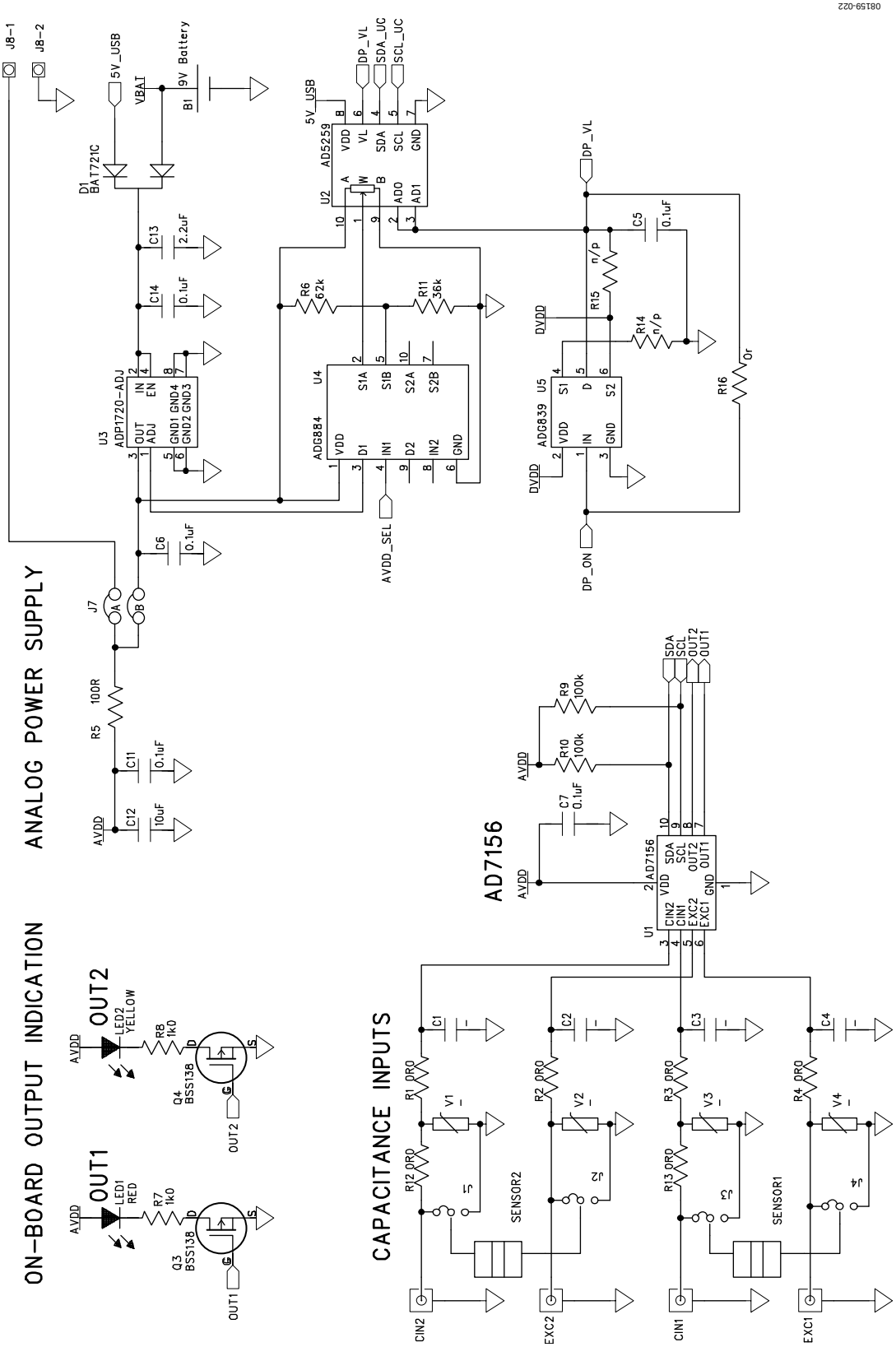

Figure 23. AD7156 Evaluation Board Schematic—Analog Part

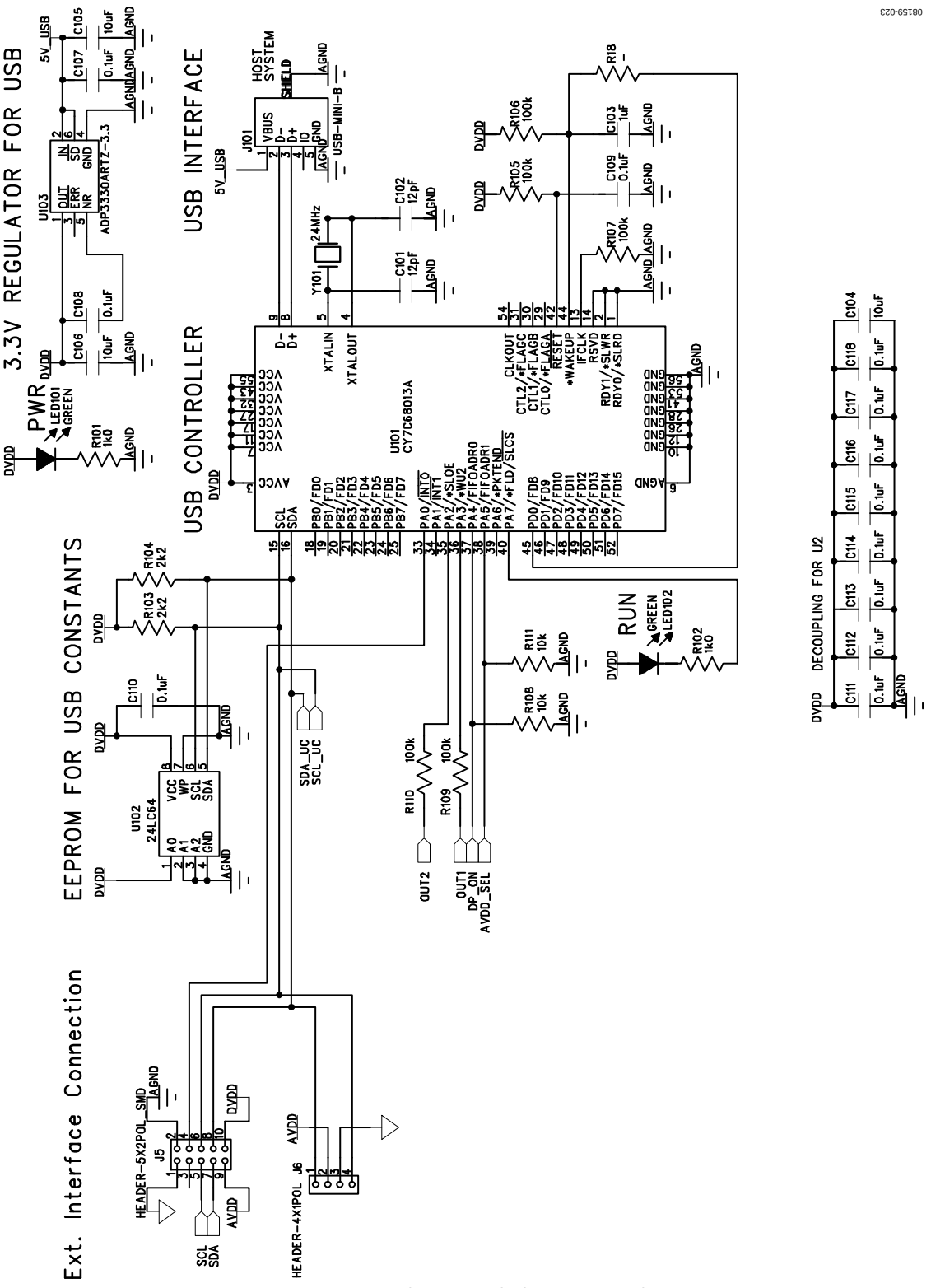

Figure 24. AD7156 Evaluation Board Schematic—Digital Part

COMPONENT ID

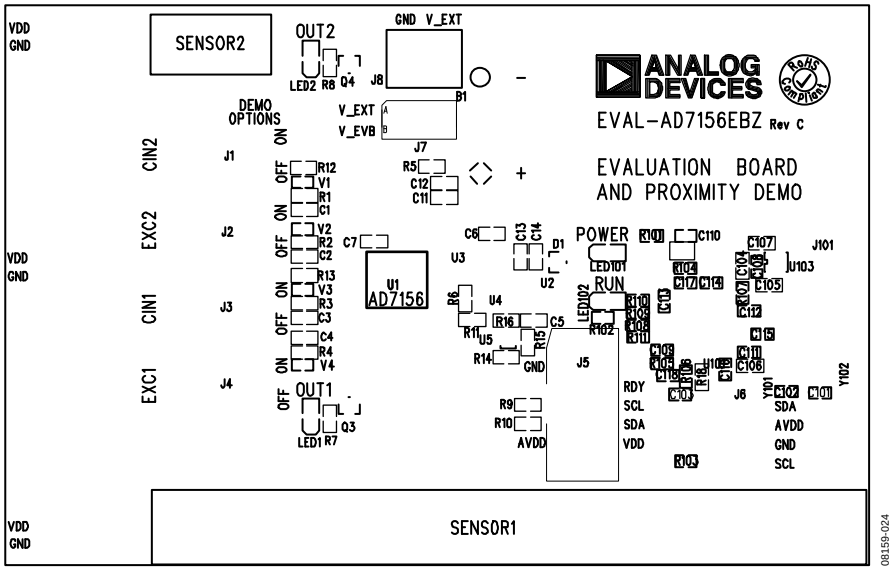

Figure 25. AD7156 Evaluation Board Layout—Silkscreen

LAYOUT

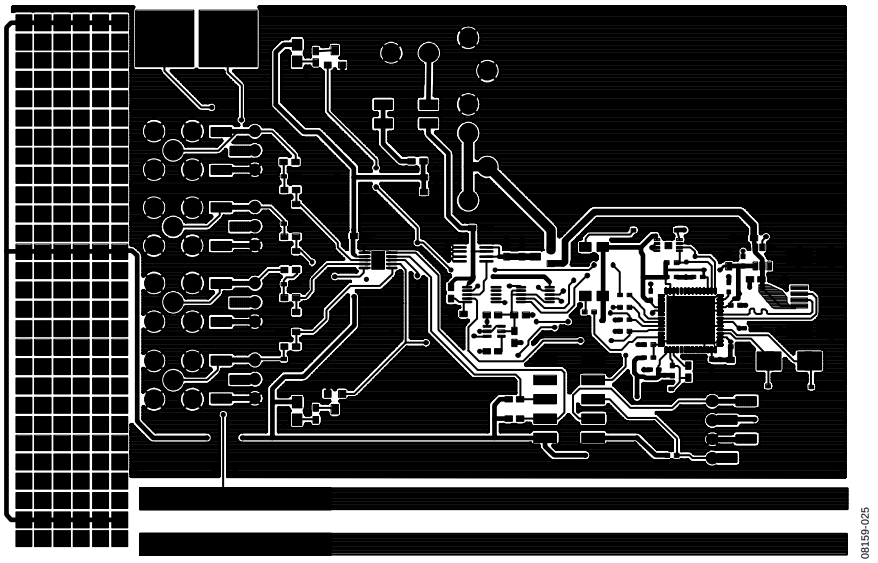

Figure 26. AD7156 Evaluation Board Layout—Component Side

ORDERING INFORMATION

BILL OF MATERIALS

Table 1. Bill of Materials

Designator	Qty	Description	Manufacturer	Part No.
PCB	1	2-layer FR4 PCB,1.6 mm × 75 mm × 115 mm		EVAL-AD7156EBZ
U1	1	CDC for proximity sensing, 10-lead MSOP	Analog Devices	AD7156BCPZ
U2	1	Nonvolatile 256-position digital potentiometer, 10-lead MSOP	Analog Devices	AD5259BCPZ
U3	1	Voltage regulator, adjustable voltage, low I_Q, 8-lead MSOP	Analog Devices	ADP1720ARMZ
U4	1	0.5 Ω CMOS dual 2:1 MUX/SPDT audio switch	Analog Devices	ADG884BRMZ-REEL7
U5	1	Mux	Not inserted	Not inserted
U101	1	Microcontroller, EZ-USB FX2LP microcontroller, 56-lead QFN	Cypress	CY7C68013A-56LFXC
U102	1	EEPROM, I^2C, 64 kb, 8-DFN	Microchip	24LC64T-I/MC
U103	1	Voltage regulator, 3.3 V, low I_Q, SOT-23-6	Analog Devices	ADP3330ARTZ3.3
D1	1	Diode, Schottky, 40 V, 0.2 A, SOT-23	Philips	BAT721C
Q3, Q4	2	Transistor, N-MOSFET, 60 V, 0.23A, SOT-23	Infineon	BSS138N
LED1	1	LED, red, high intensity (>100 mCd), 0805	Kingbright	KP-2012SURC
LED2	1	LED, orange, high intensity (>100 mCd), 0805	Kingbright	KP-2012SEC
LED101, LED102	2	LED, green, high intensity (>50 mCd), 0805	Kingbright	KP-2012MGC
Y101	1	Crystal, 24 MHz, 12 pF, CMS-8 series	ECS	ECS-240-12-20A-TR
V1 to V4	4	Protection component, 0402	Not inserted	Not inserted
C1 to C4	4	Capacitor ceramic	Not inserted	Not inserted
C5 to C7, C11, C14, C107	6	Capacitor ceramic, 0.1 µF, 16 V, X7R, 0603	Murata	GRM188R71C104K
C12, C104 to C106	4	Capacitor ceramic,10 µF, 6.3 V, X5R, 0603	Murata	GRM188R60J106M
C13,	1	Capacitor ceramic, 2.2 µF, 16 V, X5R, 0603	Murata	GRM188R61C225K
C101, C102	2	Capacitor ceramic, 12 pF, 50 V, C0G, 0402	Murata	GRM1555C1H120J
C103	1	Capacitor ceramic, 1 µF, 6.3 V, X5R, 0402	Murata	GRM155R60J105K
C108 to C118	11	Capacitor ceramic, 0.1 µF, 16 V, X7R, 0402	Murata	GRM155R71C104K
R1 to R4, R12, R13, R16	7	Resistor, 0.0 Ω, 0603	Phycomp	232270296001
R5	1	Resistor, 100 Ω, 1%, 0603	Phycomp	232270461001
R6	1	Resistor, 62 kΩ, 1%, 0603	Vishay	CRCW060362K0FKEA
R7, R8	2	Resistor, 1.0 kΩ, 1%, 0603	Phycomp	232270461002
R9, R10	2	Resistor, 100 kΩ, 1%, 0603	Phycomp	232270461004
R11	1	Resistor, 36 kΩ, 1%, 0603	Vishay	CRCW060336K0FKEA
R14, R15, R18	3	Resistor	Not inserted	Not inserted
R101, R102	2	Resistor, 1.0 kΩ, 1%, 0402	Phycomp	232270671002
R103, R104	2	Resistor, 2.2 kΩ, 1%, 0402	Phycomp	232270672202
R105 to R107, R109, R110	5	Resistor, 100 kΩ, 1%, 0402	Phycomp	232270671004
R108, R111	2	Resistor, 10 kΩ, 1%, 0603	Phycomp	232270671003
J1 to J4	4	Header, straight, 2.54 mm pitch, 1 × 3-pin	Samtec	TSM-103-01-T-SV
J1 to J4	4	Jumper, 2-way, 2.54 mm pitch	FCI	68786-202LF
J5	1	Header straight, 2.54 mm pitch, 2 × 5-pin	OUPIIN	3012-A10G00DBA
J5	2	Jumper, 2-way, 2.54 mm pitch	FCI	68786-202LF
J6	1	Header, straight, 2.54 mm pitch, 1 × 4-pin	Samtec	TSM-104-01-T-SV
J7	1	Header, straight, 2.54 mm pitch, 2 × 2-pin	Samtec	TSM-102-01-T-DV
J7	1	Jumper, 2-way, 2.54 mm pitch	FCI	68786-202LF
J8	1	2-pin terminal block, 5 mm pitch	Lumberg	KRM 02
J101	1	Connector, USB Mini-B, SMD	Molex	54819-0578
CIN1, CIN2, EXC1, EXC2	4	Connector, SMB 50 Ω, PCB straight	Amphenol	SMB1251B1-3GT30G-50
B1	1	Clip for 9 V battery, PCB mounting	Keystone	593+594
	4	Feet, stick-on, 9.5 mm diameter, 3.8 mm height	3M	SJ5306TRANS

ORDERING GUIDE

Model	Description
EVAL-AD7156EBZ[1]	Evaluation Board

[1] 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.

NOTES

NOTES

Purchase of licensed I²C components of Analog Devices or one of its sublicensed Associated Companies conveys a license for the purchaser under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to the I²C Standard Specification as defined by Philips.

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