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The EVAL-MICCANVASZ Microphone Canvas Evaluation Board

FEATURES

- 15 MEMS microphones
  - Level-matched to within ±1 dB for accurate beam steering
  - Symmetrically arranged to create flexible array patterns
- 14 microphone indicator LEDs
  - Can be used to indicate beam direction, microphone activity, direction of incident sound, or other functions
- 8 LEDs in a bar graph meter orientation
- Seamless operation as a daughter card for EVAL-ADAU1467Z
  - Can be used with other processors via either two TDM8 or one TDM16 serial audio interface for the microphones and an SPI-compatible serial interface for the LEDs

DOCUMENTS NEEDED

ADAU1463 or ADAU1467 data sheet
EVAL-ADAU1467Z user guide

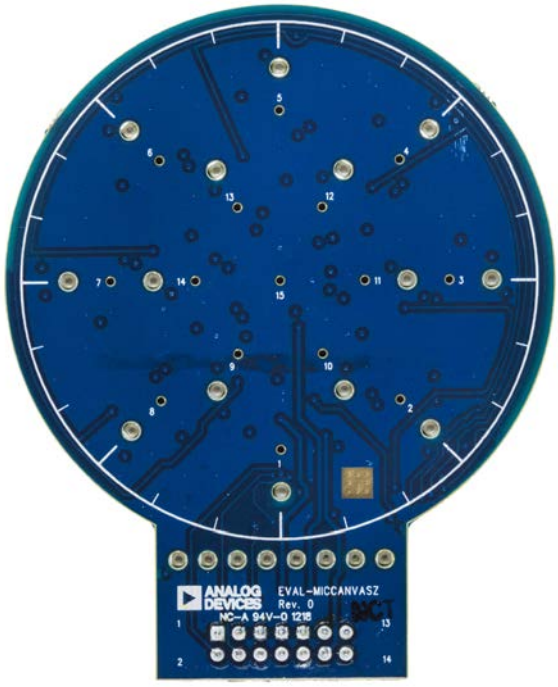
SOFTWARE NEEDED

SigmaStudio software

GENERAL DESCRIPTION

The EVAL-MICCANVASZ microphone canvas provides a platform for the development and evaluation of microphone beamforming arrays. 15 microphones, arranged as a ring of eight, a ring of six, and a single in the center, provide flexibility and symmetry suitable to many applications (see Figure 1).

EVALUATION BOARD PHOTOGRAPH



16827-001

Figure 1.

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REVISION HISTORY

11/2018—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

INSTALLATION INTO THE EVAL-ADAU1467Z

The microphone canvas comes with one nylon screw and one nylon standoff. These are used to support the cantilevered weight of the board and avoid contact with test points on the EVAL-ADAU1467Z. To install the EVAL-ADAU1467Z, take the following steps:

1. Insert the screw up from the bottom of the board through-hole (SC3).
2. Thread the standoff tightly onto the screw hand.
3. Insert the microphone canvas board into Header J5 such that it rests on the nylon standoff.

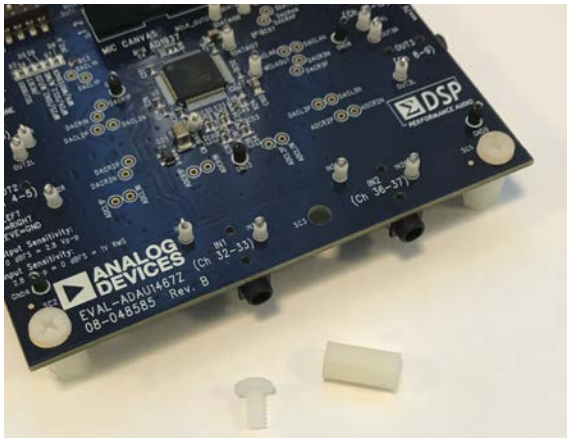

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Figure 2. Nylon Screw and Standoff

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Figure 3. Nylon Screw and Standoff Fitted in Place

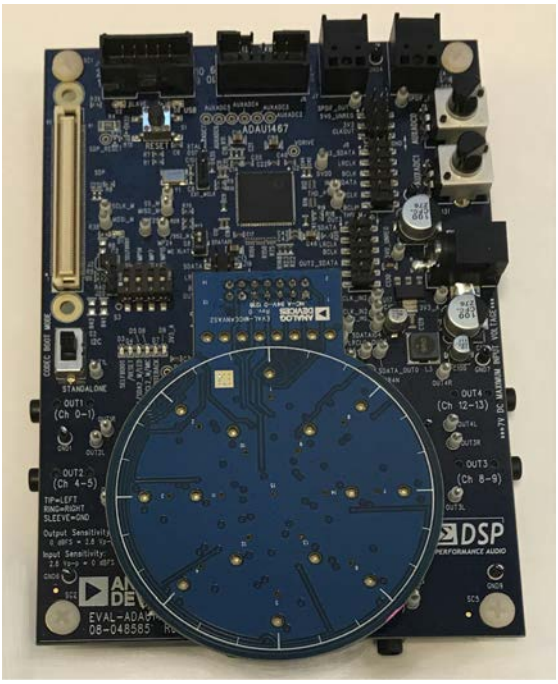

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Figure 4. Microphone Canvas Installed

SETTING SWITCHES ON THE EVAL-ADAU1467Z

On the EVAL-ADAU1467Z, ensure that the S2 switch is set to STANDALONE (down position) and that the S8 switch is set to MC XLAT (down position).

SOFTWARE CONFIGURATION

INSTALLING SigmaStudio

The programming environment for the ADAU1467 is SigmaStudio®. This graphical tool suite is available as a free download on the Analog Devices, Inc., website. The instructions for downloading and installing SigmaStudio are available in the EVAL-ADAU1467Z user guide.

LOCATING AND CONFIGURING THE LED DRIVERS

The brightness of each of the light emitting diodes (LEDs) is controlled by a dedicated pulse width modulation (PWM) controller on the microphone canvas. The drivers for this controller are available for download at www.analog.com/EVAL-MICCANVAS.

There are two blocks in the in the **LEDs** folder in the nesting list, as shown in Figure 5. The **LED PWM Controller** block controls the brightness of each of the LEDs. The bar graph meter simplifies use of LEDs D15 to D22 as an audio level meter.

The LED PWM controller block uses the MPxx pins to communicate with the controlled IC. MP16, MP17, MP18, MP19, MP24, and MP25 must be configured as shown in Figure 6. These settings can be found under the **Hardware Configuration** > **Multipurpose1** tab. Additional functionality of each of these pins is detailed in Table 1.

The blocks shown in Figure 5 appear in the SigmaStudio tree toolbox.

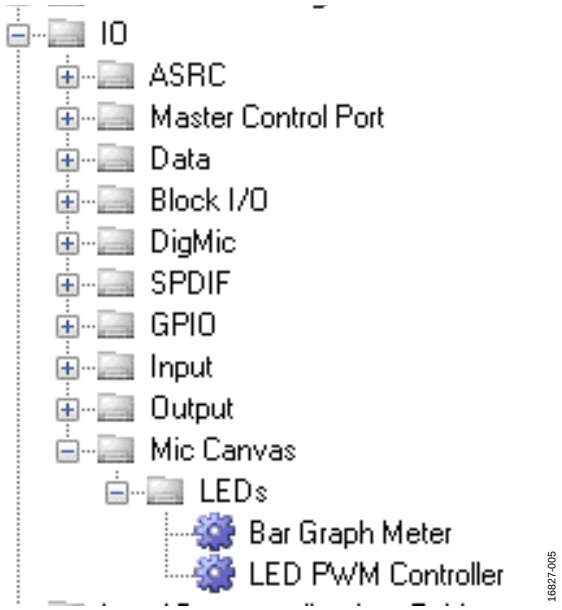

Figure 5. Toolbox Blocks for LED Control

Figure 6. MPxx Pin Configuration in SigmaStudio

INTERFACING THE MICROPHONE CANVAS TO THE EVAL-ADAU1467Z

The EVAL-MICCANVASZ evaluation board is used as a daughter card for the EVAL-ADAU1467Z evaluation board with the ADAU1467 SigmaDSP processor, controlling the microphone canvas. The connector includes provisions to power and stream the audio inputs from the 15 microphones, and also has dedicated pins and software to control the brightness of the LEDs. The functions of these pins are detailed in Table 1.

The audio interface uses Serial Input Port 1. The audio data uses two data pins, SDATA_IN1 and SDATAIO1, each in TDM8 format. Power to the microphones can be turned on and off with the digital signal processor (DSP).

The brightness of each of the 22 LEDs can be controlled independently using a PWM controller on the microphone canvas. This controller has a flexible serial interface. A software block is provided that implements this serial interface using only four multipurpose pins. This controller block provides an abstraction layer that allows control of the LEDs within the audio signal flow of a SigmaStudio project.

USING EVAL-MICCANVASZ IN TDM16 MODE

By default, the EVAL-MICCANVASZ evaluation board is configured to work seamlessly with the EVAL-ADAU1467Z evaluation board using two data lines, each configured in TDM8 mode. However, the board can also be configured to use a single data line in TDM16 mode by making minor adjustments to the printed circuit board (PCB). To configure the board for operation in TDM16 mode,

1. Move Resistor R4 to the unpopulated site, R5. R4 is a 0 Ω jumper. Leave R4 unpopulated. R5 can be bridged with any piece of wire.
2. Move Resistor R7 to the unpopulated site, R6. R7 is a 0 Ω jumper. Leave R7 unpopulated. R6 can be bridged with any piece of wire.
3. Remove Resistor R3 and leave the site unpopulated.

With these modifications, the required frame synchronization signal remains the same, the required bit clock changes from 12.288 MHz (TDM8 at 48 kHz) to 24.576 MHz (TDM16 at 48 kHz), and the data output rate doubles to match the bit clock.

Table 1. ADAU1467 Pins Used to Control Microphone Canvas

Microphone Canvas Connection	ADAU1467 Pin	Function	Comments
Microphone Power	SLC2_M/MP24	Powers the microphones	Assert SLC2_M/MP24 low to power the microphones
Microphone Bit Clock	BCLK_IN1	12.288 MHz, delayed by 1	Serial Input Port 1
Microphone Frame Synchronization	LRCLK_IN1/MP11	48 kHz, noninverted pulse	Serial Input Port 1
Microphone TDM8 Channel 0 to Channel 7	SDATA_IN1	Audio data, TDM8 format, 24-bit data, 32 bits per word	Serial Input Port 1 in TDM16 over 2 mode
Microphone TDM8 Channel 8 to Channel 15	SDATAIO1/MP17	Audio data, TDM8 format, 24-bit data, 32 bits per word	Serial Input Port 1 in TDM16 over 2 mode
Microphone TDM16 Channel 0 to Channel 15	SDATA_IN1	Audio data, TDM16 format, 24-bit data, 32 bits per word	Serial Input Port 1 in TDM16
SDATAIO1/MP17	SDATAIO1	Not applicable	Not applicable
LED Controller Blanking	SDA2_M/MP25	Enables PWM control of the LEDs	Assert SDA2_M/MP25 low to enable the use of the LED PWM controller
LED Controller XLAT	SDATAIO0/MP16	PWM controller latch input	S8 selects an alternate function for this pin
LED Controller SDATA	SDATAIO3/MP19	PWM controller data input	
LED Controller SCLK	SDATAIO2/MP18	PWM controller clock input	

MICROPHONE INPUTS ON THE EVAL-ADAU1467Z

The microphone canvas uses microphones that output audio in time division multiplexed (TDM) format, which eliminates the need for decimator interfaces, as are required with pulse density modulation (PDM) output microphones. Use of TDM format also eliminates the need for analog-to-digital converters (ADCs), as are required with analog output microphones.

Figure 7. Serial Input Port 1 Configuration

Each of the 15 microphones outputs appear as 24-bit data, left aligned in 32-bit words with I²S framing on Channel 0 through Channel 14 of Serial Input Port 1 of the SigmaDSP. TDM8 format is used, rather than TDM16 format, to reduce the required bit clock rate. An SDATAIOx pin is used to input a second data stream without requiring a second serial port. Configure Serial Input Port 1 and SDATAIO1 in SigmaStudio, as shown in Figure 7 and Figure 8. See the Using EVAL-MICCANVASZ in TDM16 Mode section for information on operating using a single audio data line.

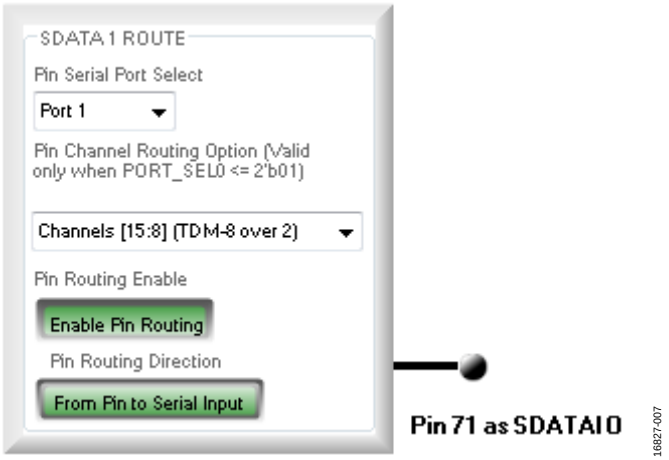

Figure 8. SDATAIO1 Pin Configuration

DRIVING THE LEDS WITH THE EVAL-ADAU1467Z

The LED PWM controller block provides a graphical interface to the hardware PWM controller, as shown in Figure 9. The top eight inputs correspond to LEDs D15 to D22, which make up the bar graph meter adjacent to the microphone canvas connector. The remaining 14 pins correspond to the LEDs adjacent to the rings of blue LEDs adjacent to the microphones. Each input provides control over the brightness of an LED. Ensure that the brightness is in the range 0.0 to (1.0 − 1 LSB).

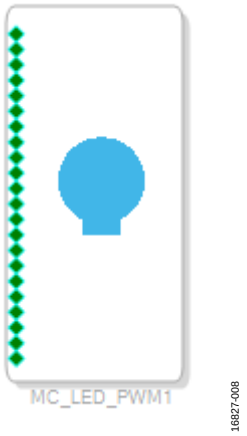

Figure 9. LED PWM Controller Block

USING THE BAR GRAPH METER

The bar graph meter block shown in Figure 10 provides a means of implementing a common audio level meter.

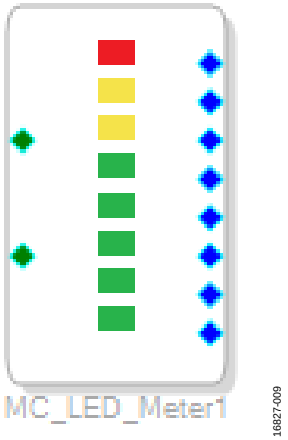

Figure 10. Bar Graph Meter Block

The top input accepts any standard audio signal. The bottom input provides control over the brightness of the meter. Ensure that the brightness is in the range 0.0 to (1.0 − 1 LSB).

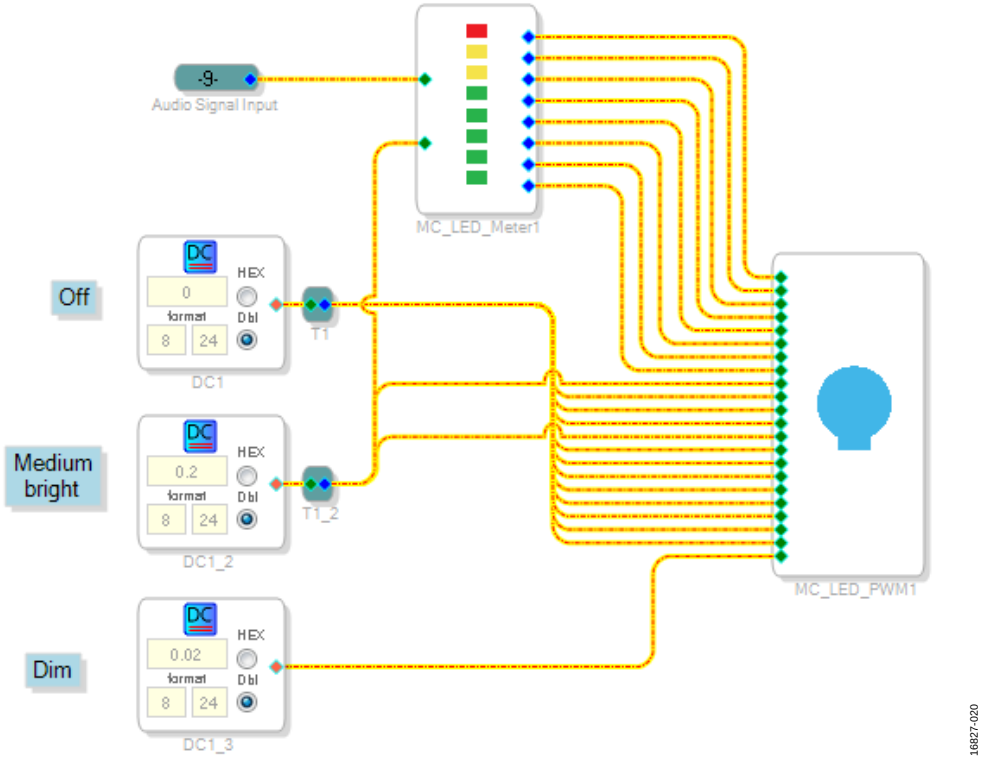

Figure 11. Example LED Control SigmaStudio Schematic

MICROPHONE USE FOR BEAMFORMING APPLICATIONS

Beamforming applications require precise spacing and level calibration of the microphones in the array. The microphone array on the microphone canvas consists of an outer ring of eight microphones placed in a circle with diameter of 40 mm, a concentric inner ring of six microphones placed in a circle with diameter of 20 mm, and a single microphone in the center. This arrangement provides symmetry for steering a virtual microphone beam around a circle and a selection of angles for evaluating microphone spacing and orientation.

Figure 12 shows examples of useful microphone spacing and angles.

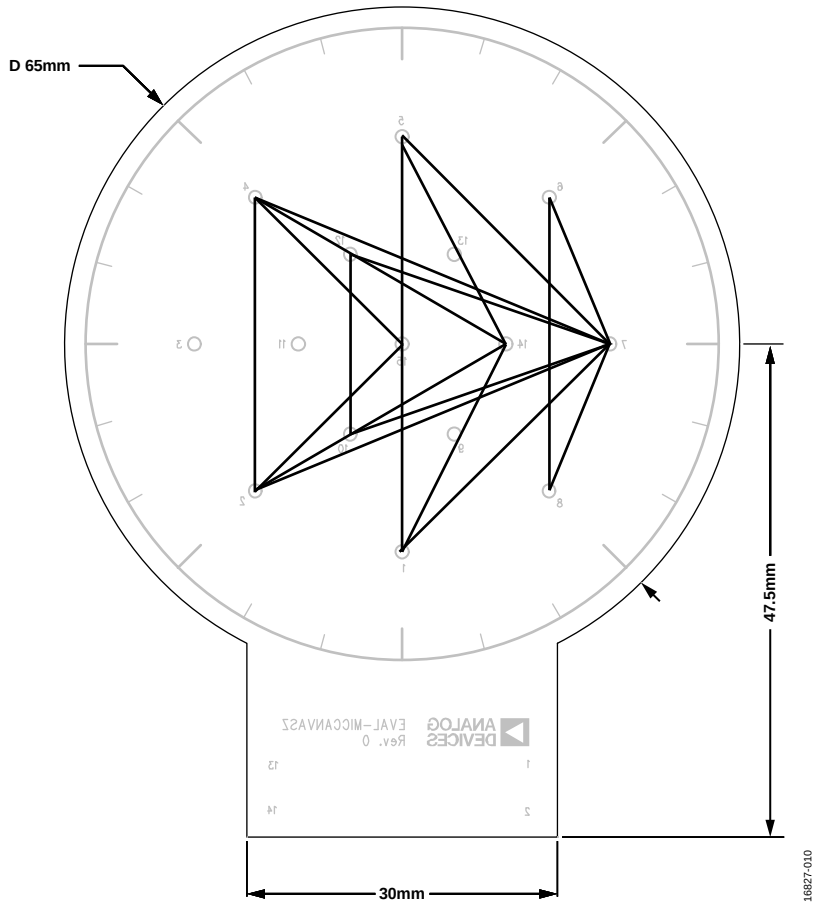

Figure 12. Example 3-Microphone Combinations

EVALUATION BOARD SCHEMATICS AND ARTWORK

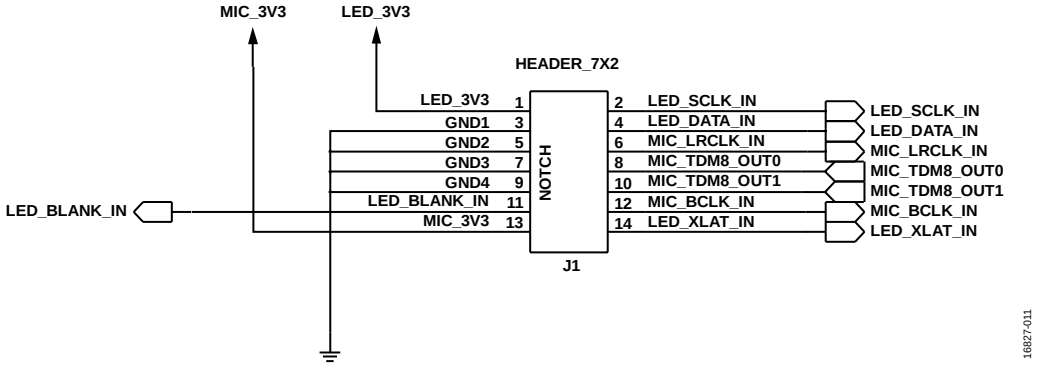

Figure 13. Connector Schematics

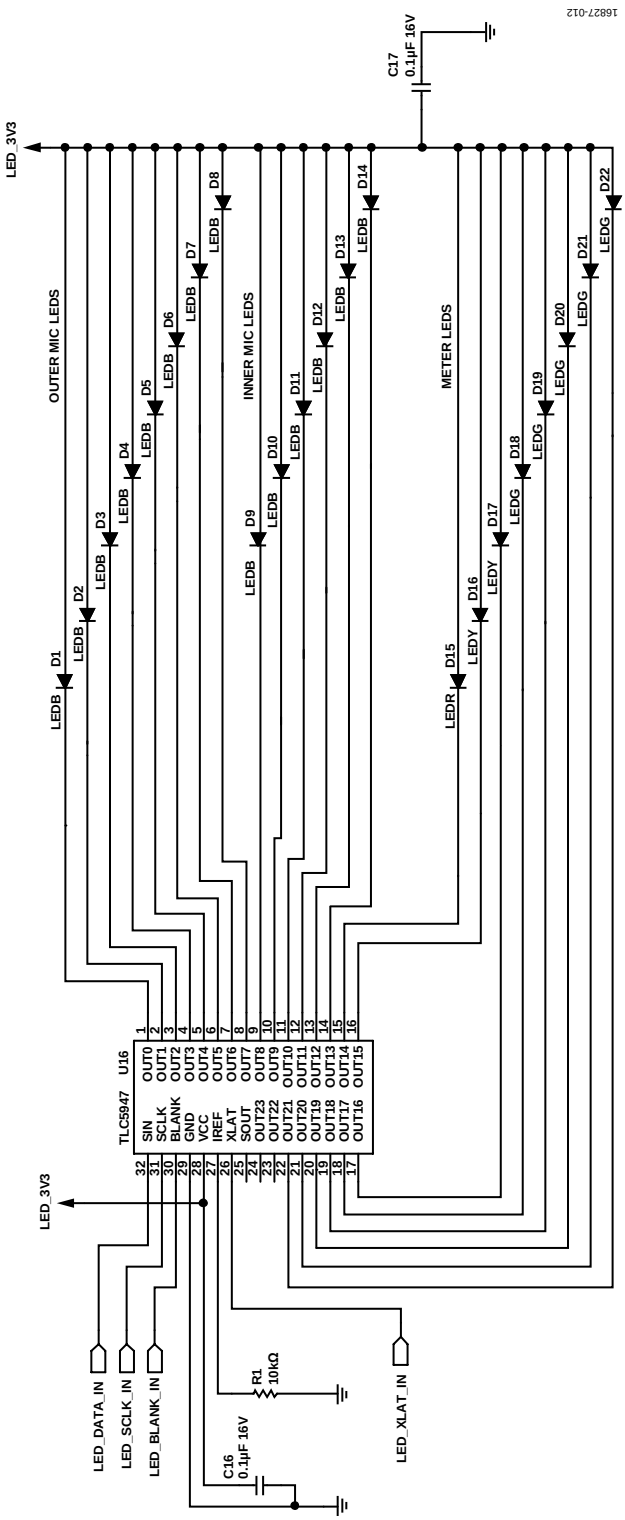

Figure 14. LED Schematics

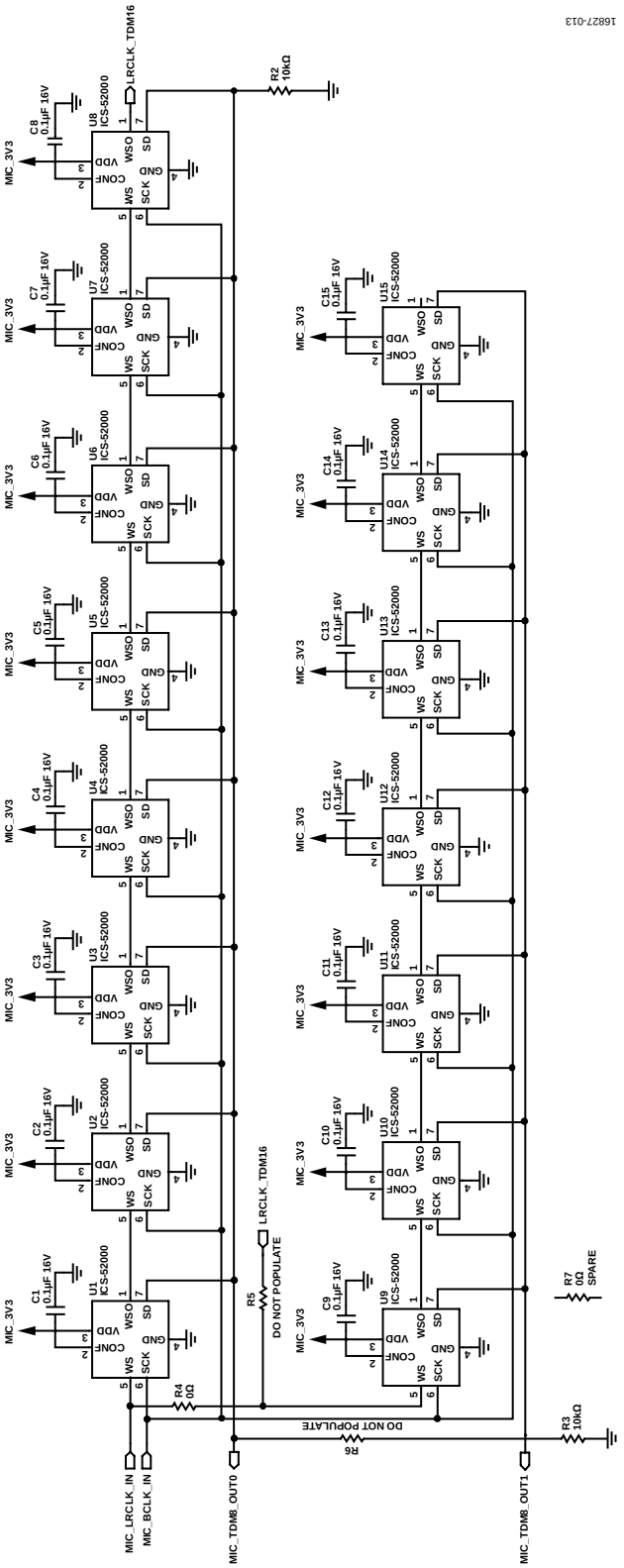

Figure 15. Microphone Schematics

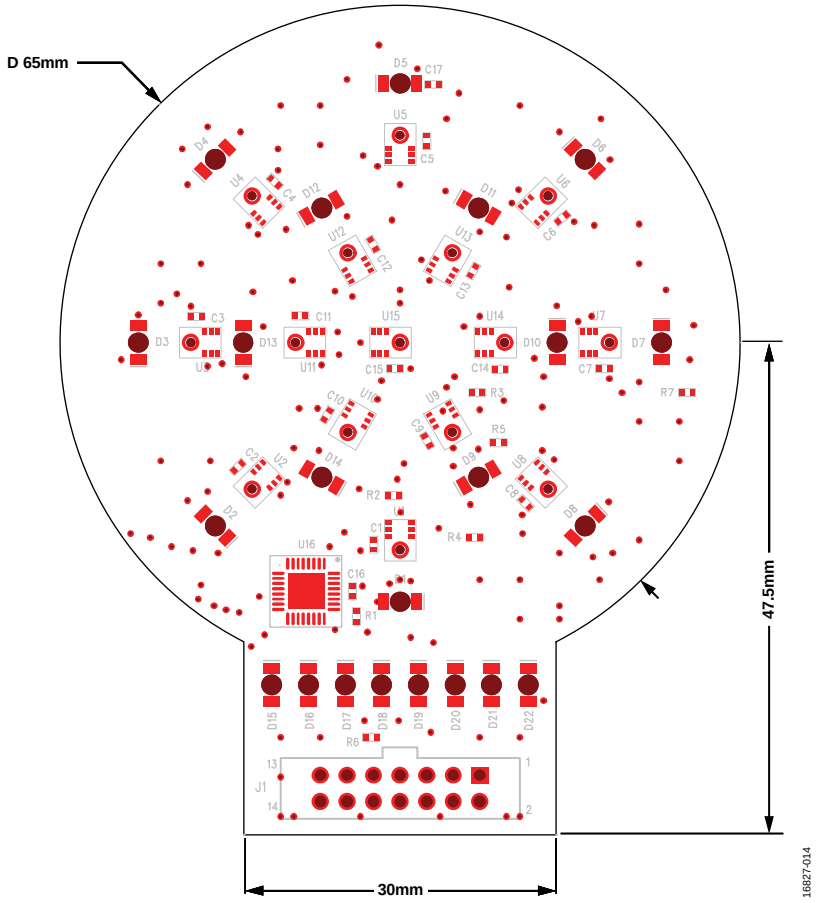

Figure 16. Top Layer Assembly and Silkscreen

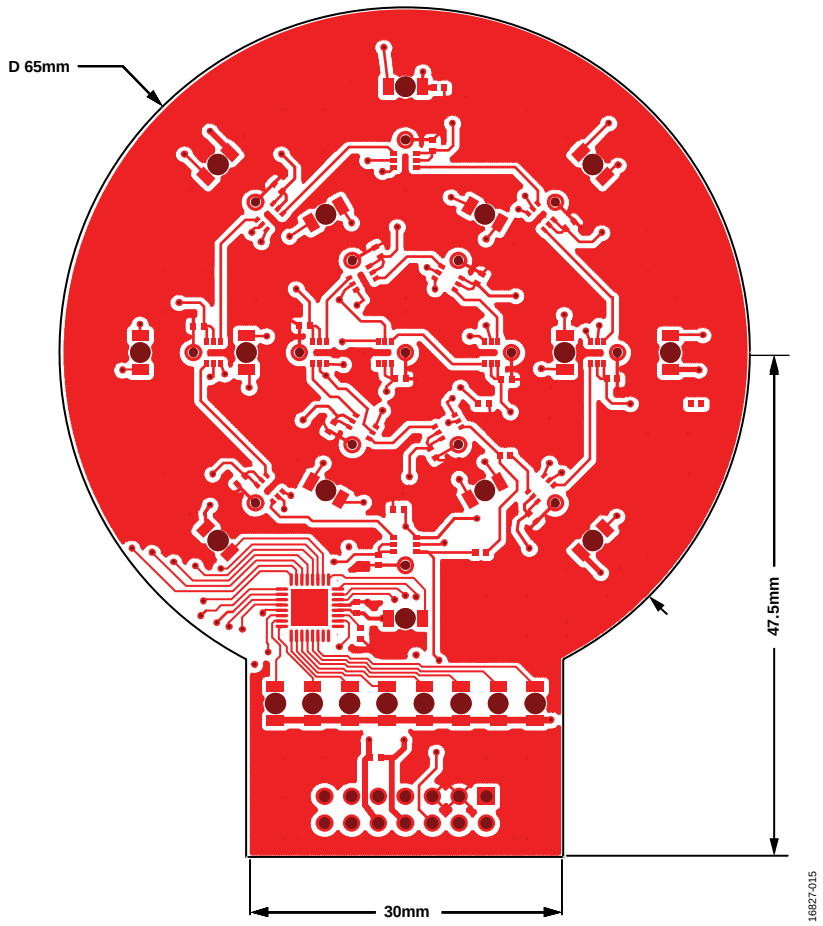

Figure 17. Layer 1 (Copper)

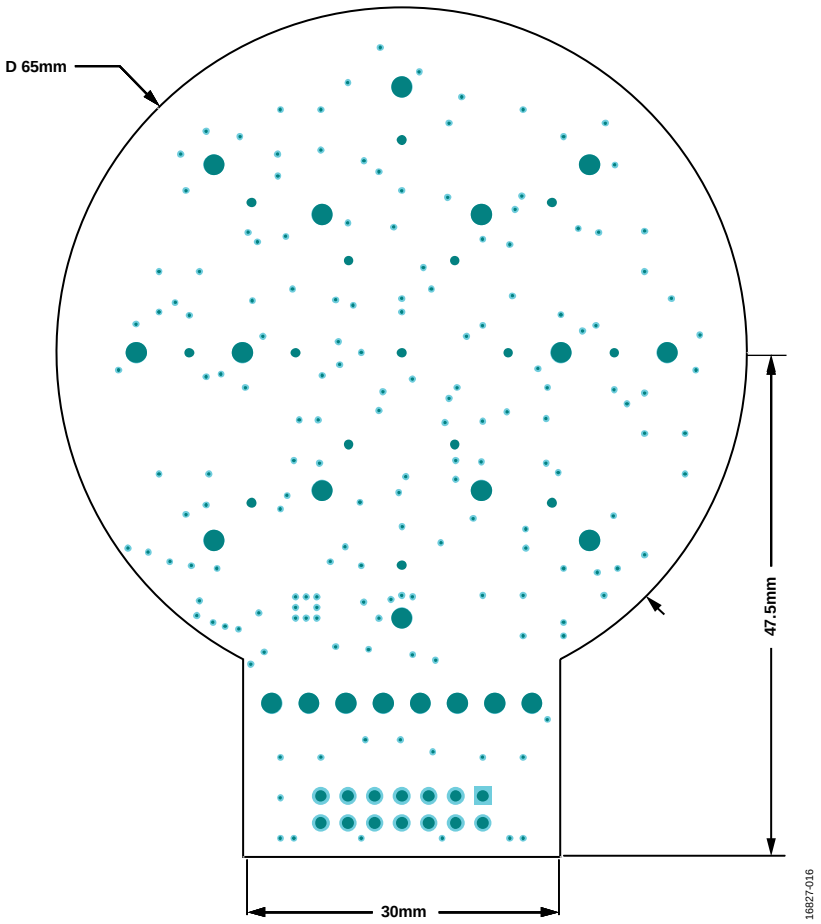

Figure 18. Layer 2 (Ground)

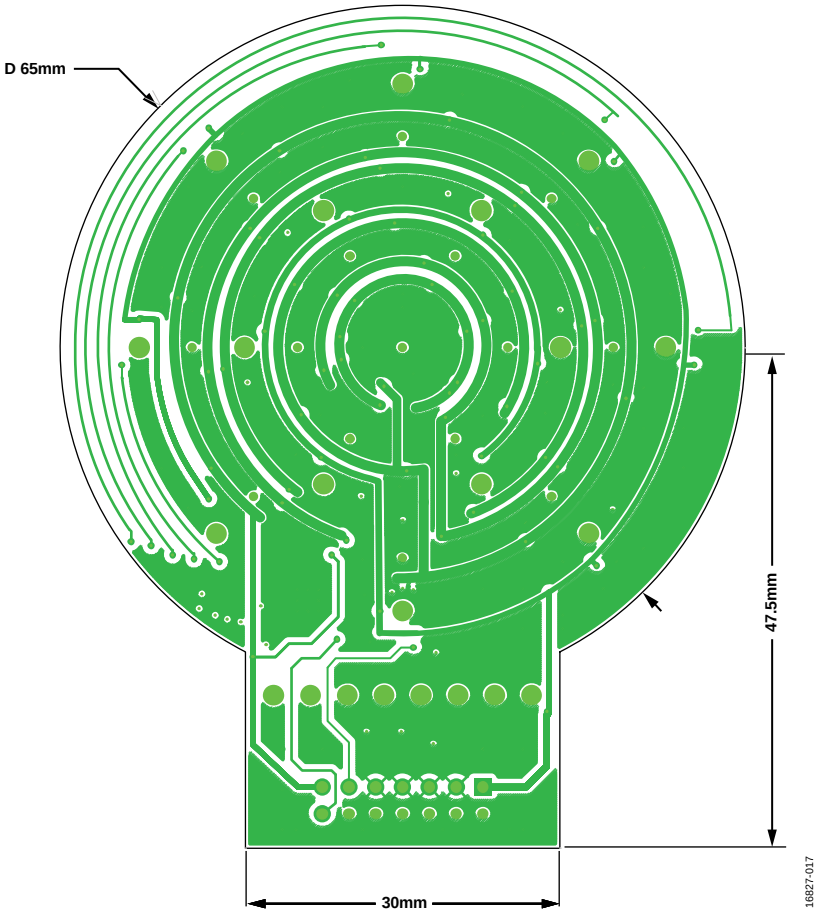

Figure 19. Layer 3 (Copper)

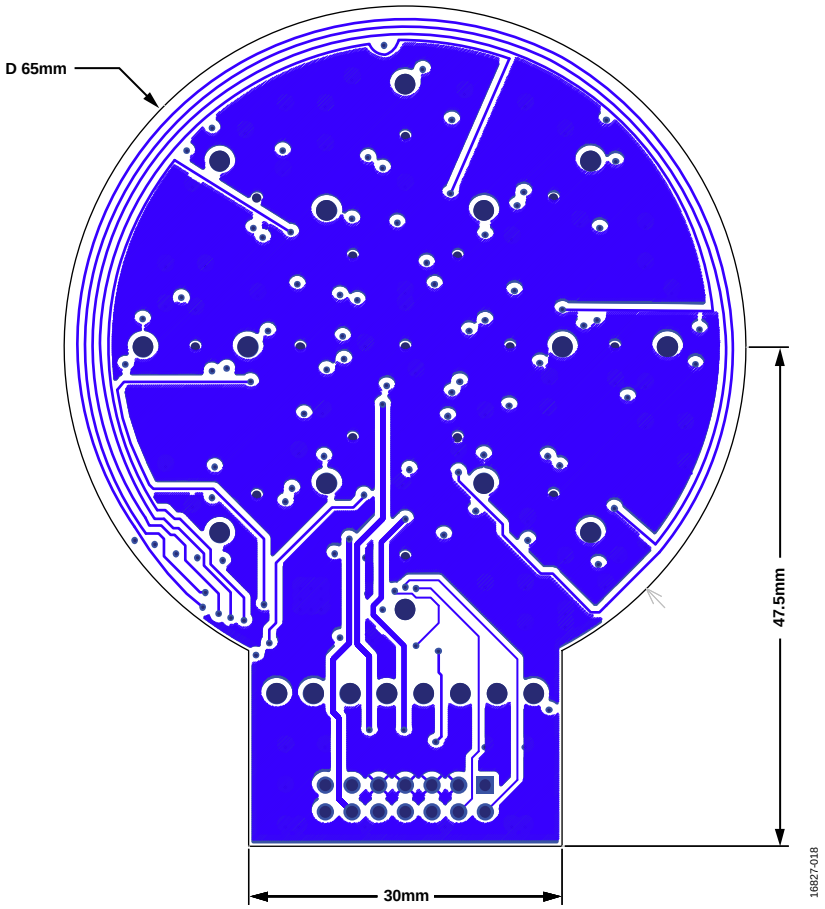

Figure 20. Layer 4 (Copper)

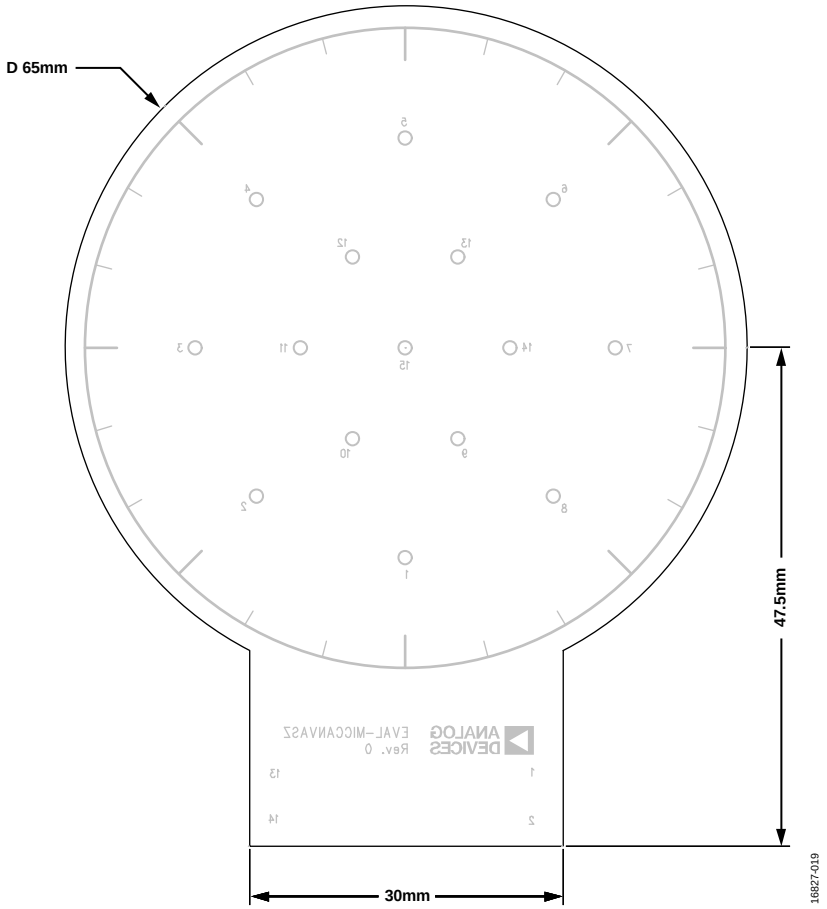

Figure 21. Bottom Silkscreen (View from Top)

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Item	Quantity	Reference Designator	Description	Manufacturer	Part Number
1	15	U1 to U15	Microelectro mechanical systems (MEMS) microphones	TDK Invensys	ICS-52000
2	1	U16	PWM LED Driver IC	Texas Instruments	TLC5947
3	17	C1 to C17	0.1 µF, 16 V, 10%, ceramic capacitors	TDK	CGA2B1X7R1C104K050BC
4	14	D1 to D14	Blue, bottom mount, LEDs	Dialight	597-6601-607F
5	1	D15	Red, bottom mount, LED	Dialight	597-6001-607F
6	2	D16, D17	Yellow, bottom mount, LEDs	Dialight	597-6401-607F
7	5	D18 to D22	Green, bottom mount, LEDs	Dialight	597-6301-607F
8	3	R1 to R3	10 kΩ,1%, resistors	Yageo	RC0402FR-0710KL
9	2	R4, R7	0 Ω, resistors (jumpers)	Panasonic	ERJ-2GE0R00X