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MAX98355 Evaluation Kit
Evaluates: MAX98355A/MAX98355B

General Description

The MAX98355 evaluation kit (EV kit) is a fully assembled and tested PCB that evaluates the MAX98355 PCM digital input Class D power amplifier. The EV kit operates from a single 2.5V to 5.5V DC power supply and is capable of delivering 3.2W into a 4Ω load. The device outputs can be connected directly to a speaker load for filterless applications. However, a filter can be added to ease evaluation. The MAX98355A accepts standard I2S data and the MAX98355B accepts left-justified digital audio data. Both ICs support time-division multiplexed (TDM) data.

Ordering Information appears at end of data sheet.

Features

♦ **2.5V to 5.5V Single-Supply Operation**

♦ **Only a Single External Component (VDD Capacitor) Required in Many Applications**

♦ **I2S, Left-Justified, or TDM Input**

♦ **Five Selectable Gains (3db, 6dB, 9dB, 12dB, and 15dB)**

♦ **No MCLK Required**

♦ **Sample Rates of 8kHz to 96kHz**

♦ **Audio Channel Select (Left, Right, or (Left + Right)/2)**

♦ **Filterless Class D Outputs**

♦ **Optional Class D Output Filters for Ease of Evaluation**

♦ **Low-Power Shutdown Mode**

♦ **Low RF Susceptibility Rejects TDMA Noise from GSM Radios**

♦ **Extensive Click-and-Pop Reduction Circuitry**

♦ **Robust Short-Circuit and Thermal Protection**

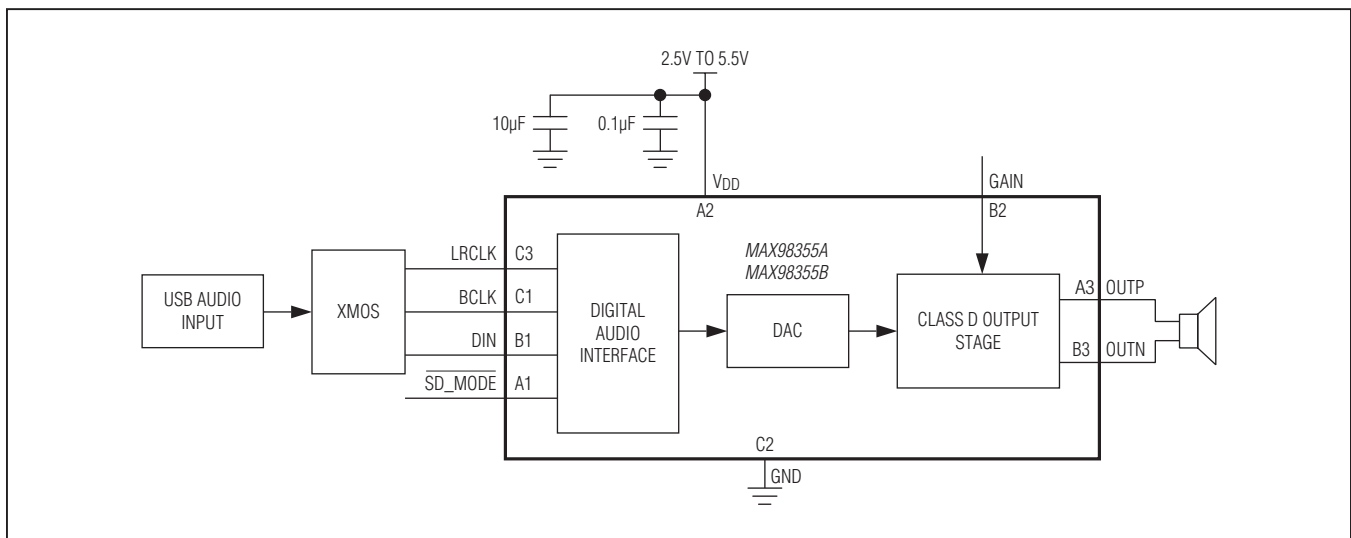♦ **Proven PCB Layout**

♦ **Fully Assembled and Tested**

Figure 1. Simplified Block Diagram

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

1

Component List

DESIGNATION	QTY	DESCRIPTION
BCLK, LRCLK, SDIN, USB5V, XMCLK	0	Not installed, test points
C1	1	10µF ±10%, 6.3V X5R ceramic capacitor (0603) Murata GRM188R60J106K
C2, C201, C202, C203, C218, C219, C220, C222, C225–C228, C231–C234	16	0.1µF ±10%, 16V X7R ceramic capacitors (0402) Murata GRM155R71C104K
C3–C9, C73, C74, C75	0	Not installed, ceramic capacitors (0402)
C200, C204, C205	3	1µF ±10%, 6.3V X5R ceramic capacitors (0402) TDK C1005X5R0J105K
C206, C235, C236	3	0.01µF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H103K
C207, C208, C213	3	1µF ±20%, 6.3V X5R ceramic capacitors (0603) Taiyo Yuden JMK107B7105MA
C209, C210	2	2.2µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J225K
C212	1	1000pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H102K
C214–C217	4	33pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H330J
C221	1	330pF ±5%, 50V C0G ceramic capacitor (0603) Murata GRM1885C1H331J
C223, C224	2	4.7µF ±10%, 10V X5R ceramic capacitors (0805) Murata GRM219R61A475K
C229, C230	2	4.7µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J475K
D200	1	Red LED (0603)
FB1, FB2	2	0Ω ±5% resistors (0603)
FB200, FB201	2	Ferrite beads (0603) Murata BLM18KG331SN1

DESIGNATION	QTY	DESCRIPTION
FOUTN, FOUTP, GND, VDD	4	Binding posts
FOUTN, FOUTP, GND (x3), VDD, +3.3V	7	20G plated solid copper bus wire, 0.25in U-shaped wire loop
GND (x3), OUTN	4	Black multipurpose test points (63mil drill size)
J1	1	USB mini-AB receptacle
J200	1	20-pin (2 x 10) IDC right-angle, polarized boxed header, 0.1in centers
JU1	1	5-pin header
JU2	1	4-pin header
JU3	1	9-pin (3 x 3) header
JU4	1	2-pin header
JU5	1	3-pin header
L1, L2	0	Not installed, 22µH inductors (6.2mm x 6.3mm)—short (PC trace) TOKO D63CB series part TOKO A916CY-220M
L201	1	3.3µH, 1.1A power inductor Sumida CDRH3D16NP-3R3NC
LEDA, LEDB	2	Green LEDs (0603)
OUTP	1	Red multipurpose test point (63mil drill size)
Q200, Q201, Q202	3	n-channel enhancement-mode FETs (SOT23) Fairchild BSS138
R1, R2	2	100kΩ ±5% resistors (0603)
R3	1	226kΩ ±1% resistor (0603)
R4	1	634kΩ ±1% resistor (0603)
R5, R6	0	Not installed, resistors (0402)
R7, R8, R9	3	0Ω ±5% resistors (0402)
R10	1	2kΩ ±1% resistor (0603)
R200	1	27kΩ ±5% resistor (0603)
R201	1	100kΩ ±5% resistor (0603)
R203, R204, R207, R210, R217, R220	6	10kΩ ±5% resistors (0603)
R205, R213	2	47kΩ ±5% resistors (0603)
R206	1	4.7Ω ±5% resistor (0603)
R208	1	20kΩ ±5% resistor (0603)
R209	0	Not installed, resistor (0603)
R211	1	8.06kΩ ±1% resistor (0603)

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R212, R219, R233, R234	4	1kΩ ±5% resistors (0603)
R218, R221	2	2.2MΩ ±5% resistors (0603)
R222	1	470Ω ±5% resistor (0603)
R223, R224	2	33Ω ±5% resistors (0603)
U1	1	I²S input Class D audio amplifier (9 WLP) Maxim MAX98355AEWL+
U200	1	XMOS processor (128 TQFP)
U201	1	SPI 1Mb flash memory (8 SO)
U202	1	USB 2.0 transceiver, ULPI (24 QFN)
U203	1	3.3V low-noise linear regulator (5 SOT23) Maxim MAX8887EZK33+T
U204	1	1.8V low-noise linear regulator (5 SC70) Maxim MAX8511EXK18+
U205	1	Voltage detector (5 SOT23)
U206	1	TinyLogic UHS dual buffer (6 SC70) Fairchild NC7WZ07P6X

DESIGNATION	QTY	DESCRIPTION
U208	1	Dual, unbuffered inverter (6 SC70) Fairchild NC7WZU04P6X
U209	1	2-input multiplexer (6 SC70) Fairchild NC7SZ157P6X
U210	1	Dual logic buffer (6 SC70) Fairchild NC7WZ17P6X
U211	1	Microprocessor-reset circuit (3 SC70) Maxim MAX803TEXR+
U212	1	1A step-down regulator (10 μMAX®) Maxim MAX1974EUB+
Y1	1	13MHz clock oscillator (2.5mm x 2.0mm)
Y200	1	24.576MHz crystal (6.0mm x 3.3mm)
Y201	1	11.2896MHz crystal (6.0mm x 3.3mm)
—	4	Shunts
—	1	PCB: MAX98355 EVALUATION KIT

Optional Components

DESIGNATION	QTY	DESCRIPTION
C3–C7	5	0.22μF ±10%, 6.3V XR5 ceramic capacitors (0402) TDK C1005X5R0J224K

DESIGNATION	QTY	DESCRIPTION
L1, L2	2	22μH, 1A inductors (6.2mm x 6.3mm) TOKO A916CY-220M
R5, R6	2	22Ω ±5% resistors (0402)

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Sumida Corp.	847-545-6700	www.sumida.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com
TOKO America, Inc.	847-297-0070	www.tokoam.com

Note: *Indicate that you are using the MAX98355 when contacting these component suppliers.*

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Quick Start

Recommended Equipment

- MAX98355 EV kit
- 2.5V to 5.5V, 2A DC power supply
- USB audio source (from computer through an audio media player such as iTunes® or Windows® Media Player)
- USB cable (included in the EV kit box)
- 4Ω to 8Ω speaker

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all necessary connections are completed.**

1) Verify that shunts are installed as follows:

   JU1: Pins 1-5 (12dB gain)

   JU2: Pins 1-3 (left audio channel selected)

   JU3: Pins 2-3 (I²S input from XMOS, MAX98355A only)

   JU4: Installed (VDDIO supplied from on-board power supply

   JU5: Pins 2-3 (device in shutdown mode)

2) Set the power-supply output to 5V. Disable the power supply.

3) Connect the power-supply ground terminal to the GND PCB pad and the power-supply positive terminal to the VDD PCB pad on the EV kit.

4) Connect the speaker across the OUTP and OUTN test points.

5) Enable the power-supply output.

6) With the audio source disabled, connect the USB audio source to J1 on the EV kit. Change the shunt on JU5 to pins 1-2 (device enabled for normal operation).

7) Enable the audio source.

8) Verify that the speakers are playing the audio source signal.

Detailed Description of Hardware

Filterless Output

The MAX98355 EV kit's filterless outputs (OUTP, OUTN) can be connected directly to a speaker load without any filtering. Use the OUTP and OUTN test points to connect the speaker directly to the device output.

Filtered Output

Audio analyzers typically cannot accept the Class D amplifier's pulse-width modulated (PWM) signals at their inputs. Therefore, the EV kit features optional lowpass filters at the outputs to ease evaluation. As shipped, the EV kit's lowpass filter RC components are unpopulated and L1, L2 are shorted on the PCB.

To use the filtered output posts (FOUTP, FOUTN), remove the shorts on L1 and L2 and install components L1, L2, C3–C7, and R5, R6 (provided separately with the EV kit). Use the output posts to connect the filtered outputs to the audio analyzer. The default lowpass filters at the EV kit output are optimized for a 4Ω speaker.

Jumper Selection
Selectable Gain (GAIN)

The EV kit features a 5-pin jumper (JU1) to control the device's five programmable gain settings. See Table 1 for gain-control configuration.

SD_MODE Input

The EV kit features a 4-pin jumper (JU2) to control the audio channel that is sent to the amplifier output and a 3-pin jumper (JU5) to enable/disable the IC. JU2 is used to select the stereo input (left channel, right channel, or the average of the left/right channels). JU5 must be set to pins 1-2 for normal operation. See Table 2 for shunt positions.

Shutdown Mode

The device features a low-power shutdown mode that is activated by setting jumper JU5 to pins 2-3. To exit shutdown mode, set JU5 to pins 1-2 and select the desired stereo input channel using jumper JU2. See Table 3 for shunt positions.

Table 1. JU1 Jumper Selection (GAIN)

SHUNT POSITION	GAIN PIN	GAIN (dB) RELATIVE TO A 2.1dBV REFERENCE LEVEL
1-2	Connected to VDD through 100kΩ resistor R1	3
1-3	Connected to VDD	6
1-4	Connected to GND through 100kΩ resistor R2	15
1-5*	Connected to GND	12
Not installed	Unconnected	9

*Default position.

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Windows is a registered trademark and registered service mark of Microsoft Corp.

External/Internal VDDIO (+3.3V)

On the EV kit, a logic voltage from a control interface is needed for proper selection of the stereo input channel through SD_MODE. This voltage can be applied externally at the +3.3V PCB pad or it can be provided from on-board circuitry. See Table 4 for shunt positions.

If the USB cable is disconnected (such as when the XMOS chip is not in use), the on-board circuitry to generate the +3.3V is not available. In this case, remove the shunt from jumper JU4 and supply an external voltage at the +3.3V PCB pad. Logic voltages other than +3.3V can be used on the EV kit. If other logic voltages are used, resistors R3 and R4 must be adjusted. See the SD_MODE and Shutdown Operation section in the MAX98355A/MAX98355B IC data sheet for more information.

Driving I2S Directly

The EV kit provides an on-board XMOS chip to generate the I2S signal from the USB audio source. To utilize the XMOS chip, all positions of jumper JU3 must be set betweens pins 2-3. To bypass the XMOS and drive the digital audio interface directly, remove the shunts from JU3 and apply signals at the BCLK, LRCLK, and SDIN test points or between JU3 pins 1-2 at the appropriate locations (pin 1 is signal ground). The XMOS chip is configured for I2S output so it cannot be used with the MAX98355B (left-justified data). To evaluate the MAX98355B with left-justified data or the MAX98355A/MAX98355B with TDM data, use the external data input option by removing the shunts from JU3 pins 2-3 and drive the digital audio interface directly.

Table 2. JU2 and JU5 Jumper Selection (SD_MODE)

SHUNT POSITION		SD_MODE PIN	DEVICE OPERATION
JU2	JU5		
1-2	1-2*	Connected to VDDIO through R3 (226kΩ resistor)	Right audio channel selected
1-3*	1-2*	Connected to VDDIO	Left audio channel selected
1-4	1-2*	Connected to VDDIO through R4 (634kΩ resistor)	Mono mix (left + right)/2
X	2-3	Connected to GND	Shutdown

*Default position.
X = Don't care.

Table 3. JU3 Jumper Selection (Digital Audio Interface)

SHUNT POSITION	BCLK, LRCLK, DIN	DEVICE OPERATION
2-3*	Connected to XMOS	XMOS IC provides I2S input data to the MAX98355A.
Not installed	Unconnected	Use this configuration when connecting an external digital audio source to the MAX98355A or when evaluating the MAX98355B. Connect external BCLK/LRCLK/DIN to column 2 and GND to column 1.

*Default position.

Table 4. JU4 Jumper Selection (VDDIO)

SHUNT POSITION	LOGIC VOLTAGE (VDDIO)
Installed*	3.3V supplied from on-board power supply.
Not installed	User-supplied external power supply applied at the +3.3V PCB pad.

*Default position.
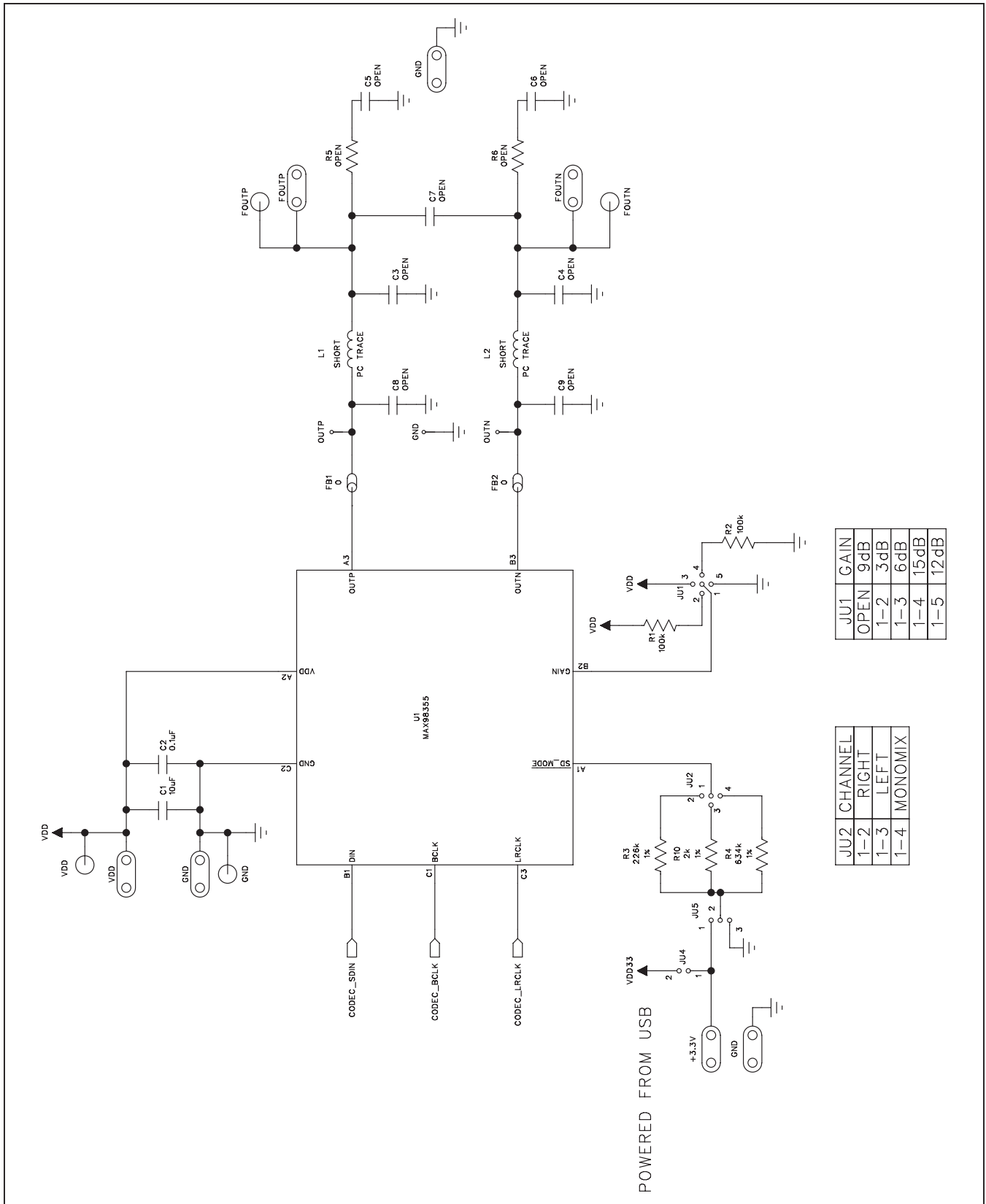
Figure 2a. MAX98355 EV Kit Schematic (Sheet 1 of 6)

JU1	GAIN
OPEN	9dB
1–2	3dB
1–3	6dB
1–4	15dB
1–5	12dB

JU2	CHANNEL
1–2	RIGHT
1–3	LEFT
1–4	MONOMIX
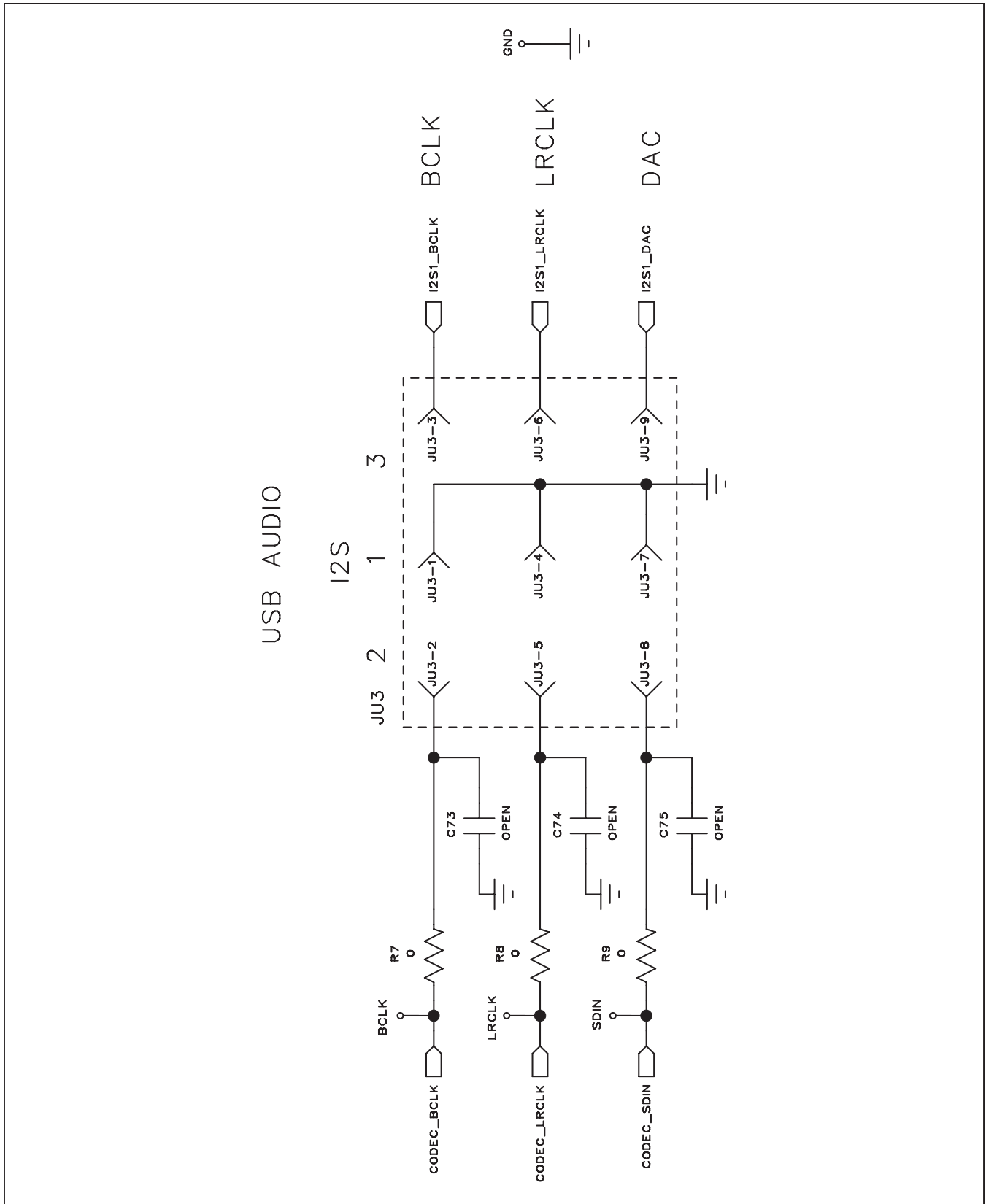
Figure 2b. MAX98355 EV Kit Schematic (Sheet 2 of 6)
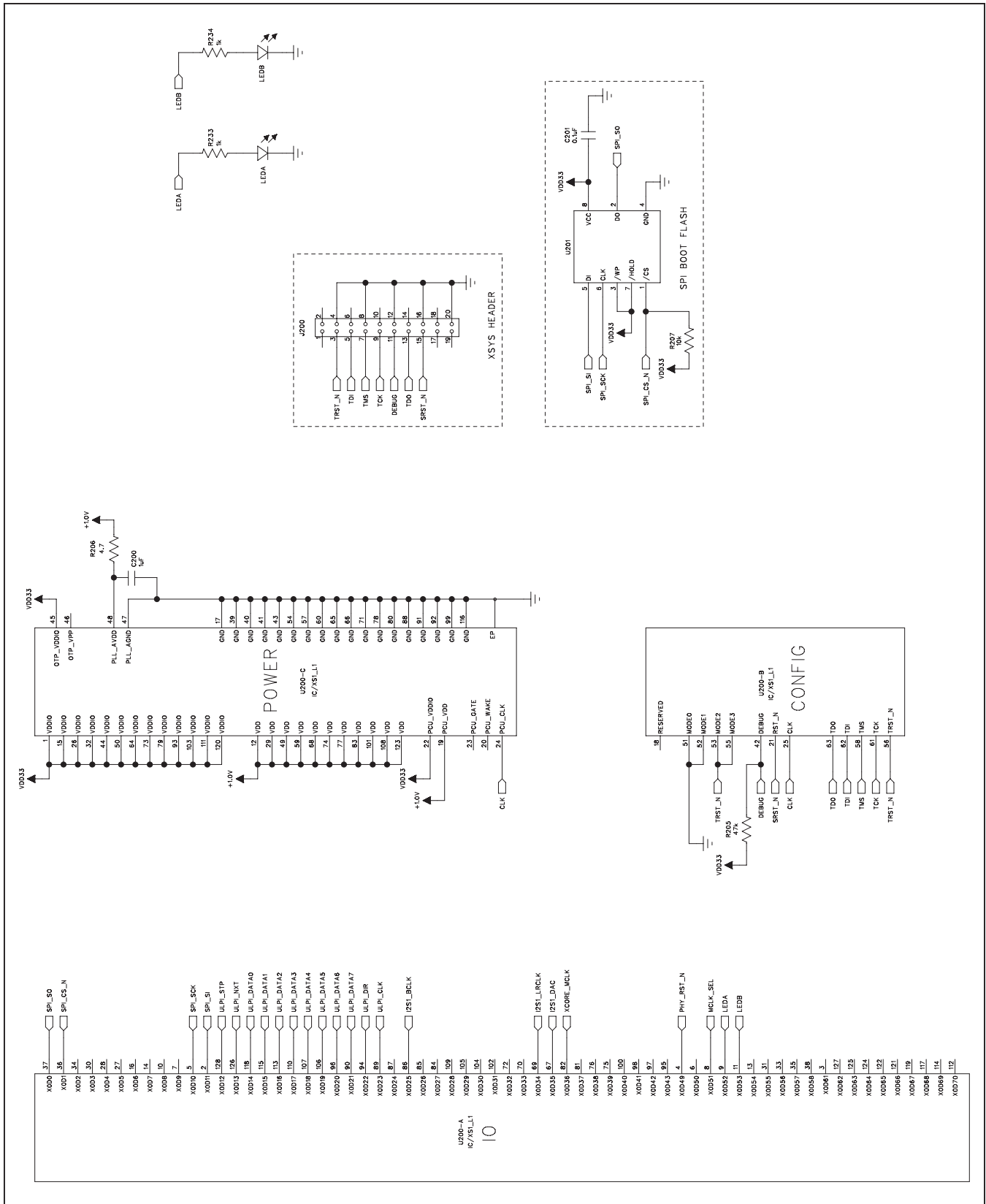
Figure 2c. MAX98355 EV Kit Schematic (Sheet 3 of 6)
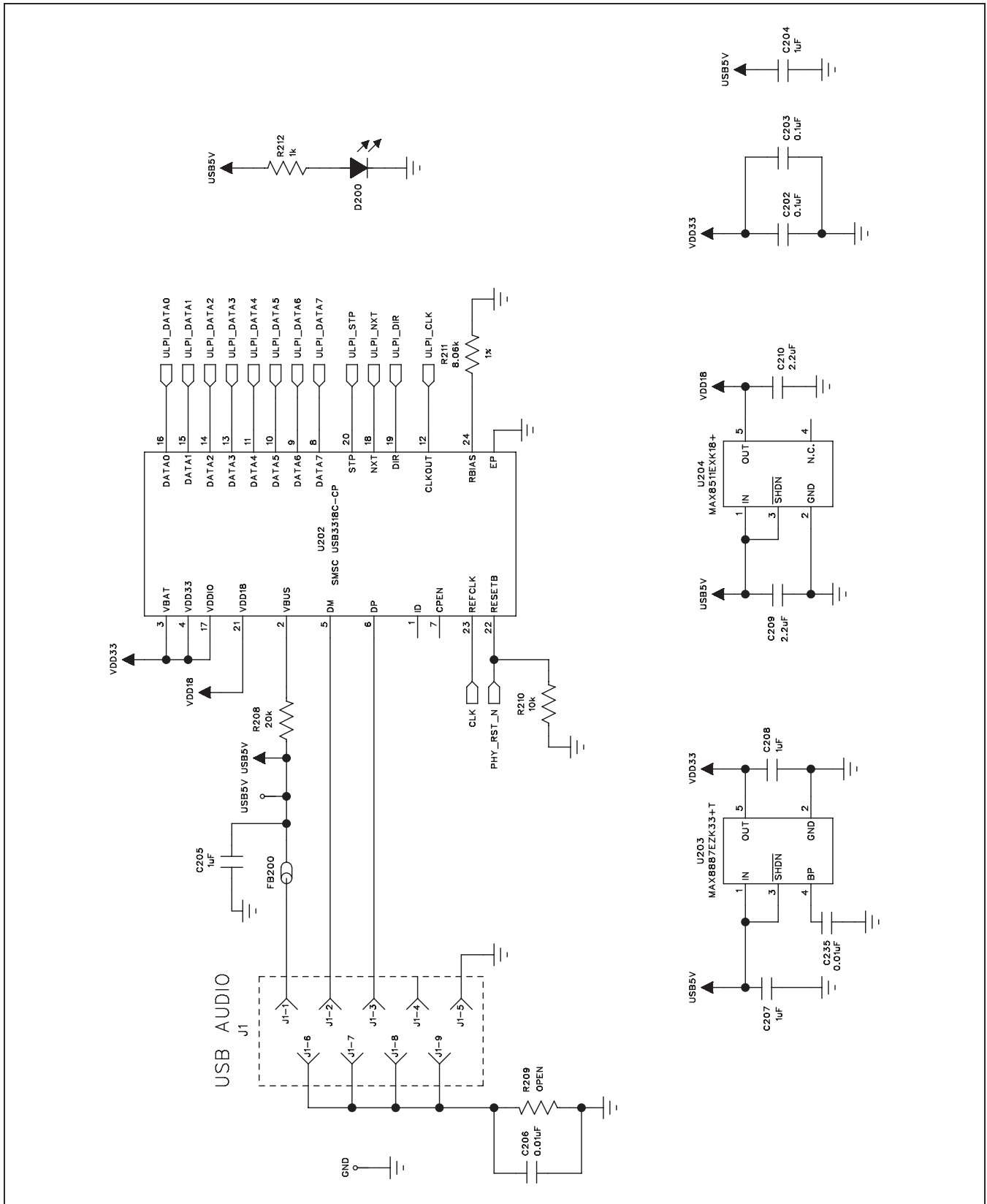
Figure 2d. MAX98355 EV Kit Schematic (Sheet 4 of 6)
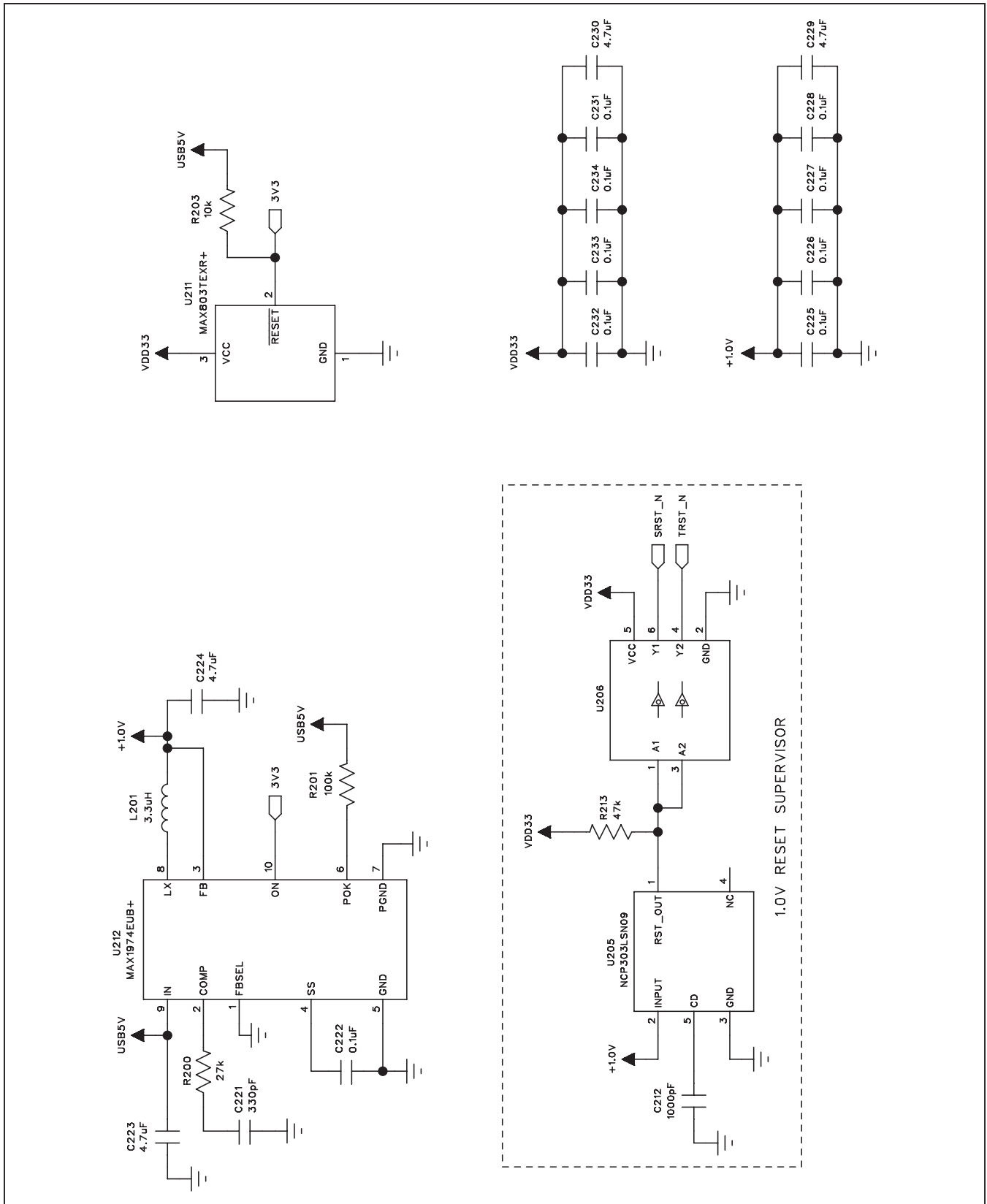
Figure 2e. MAX98355 EV Kit Schematic (Sheet 5 of 6)
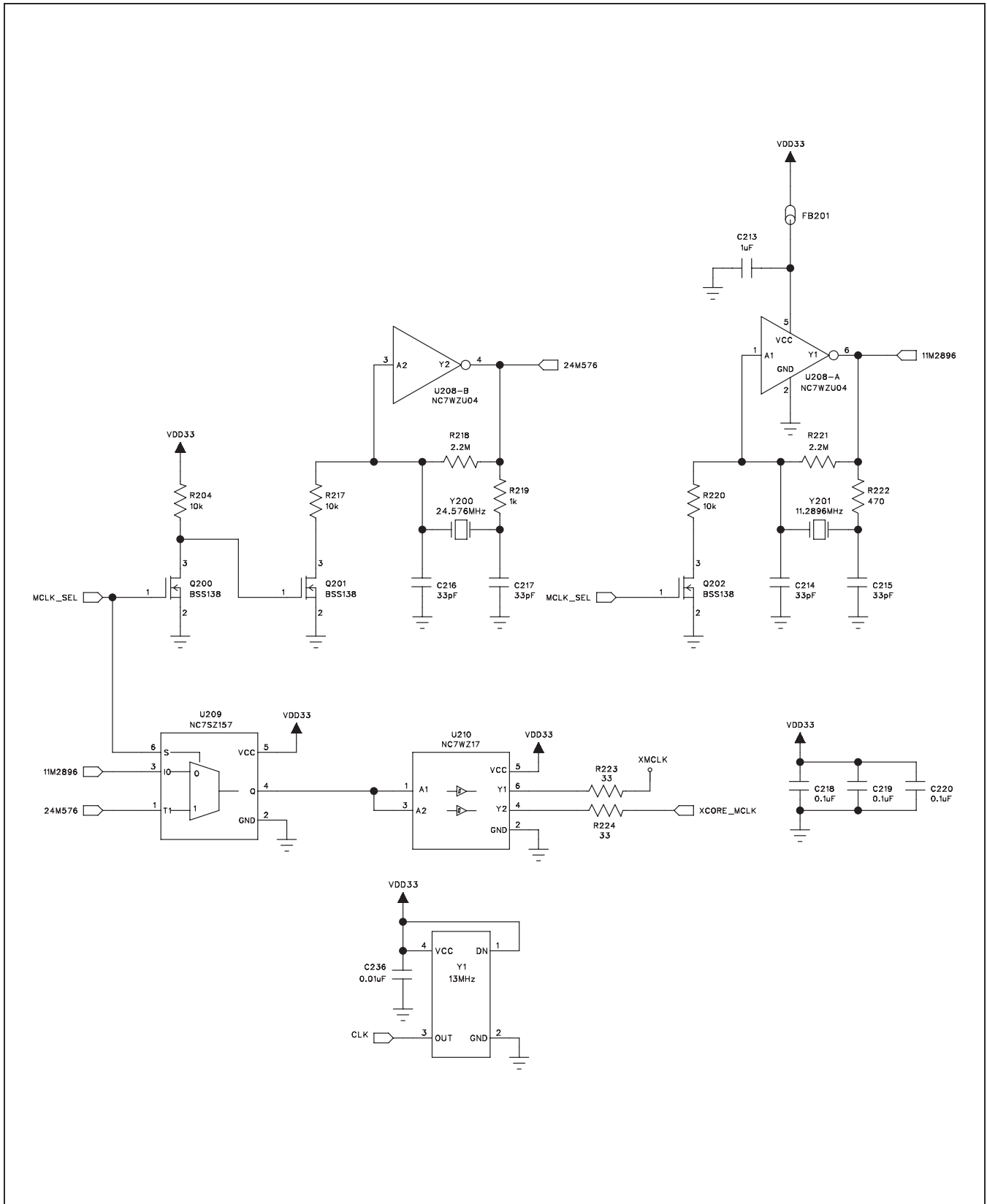
Figure 2f. MAX98355 EV Kit Schematic (Sheet 6 of 6)
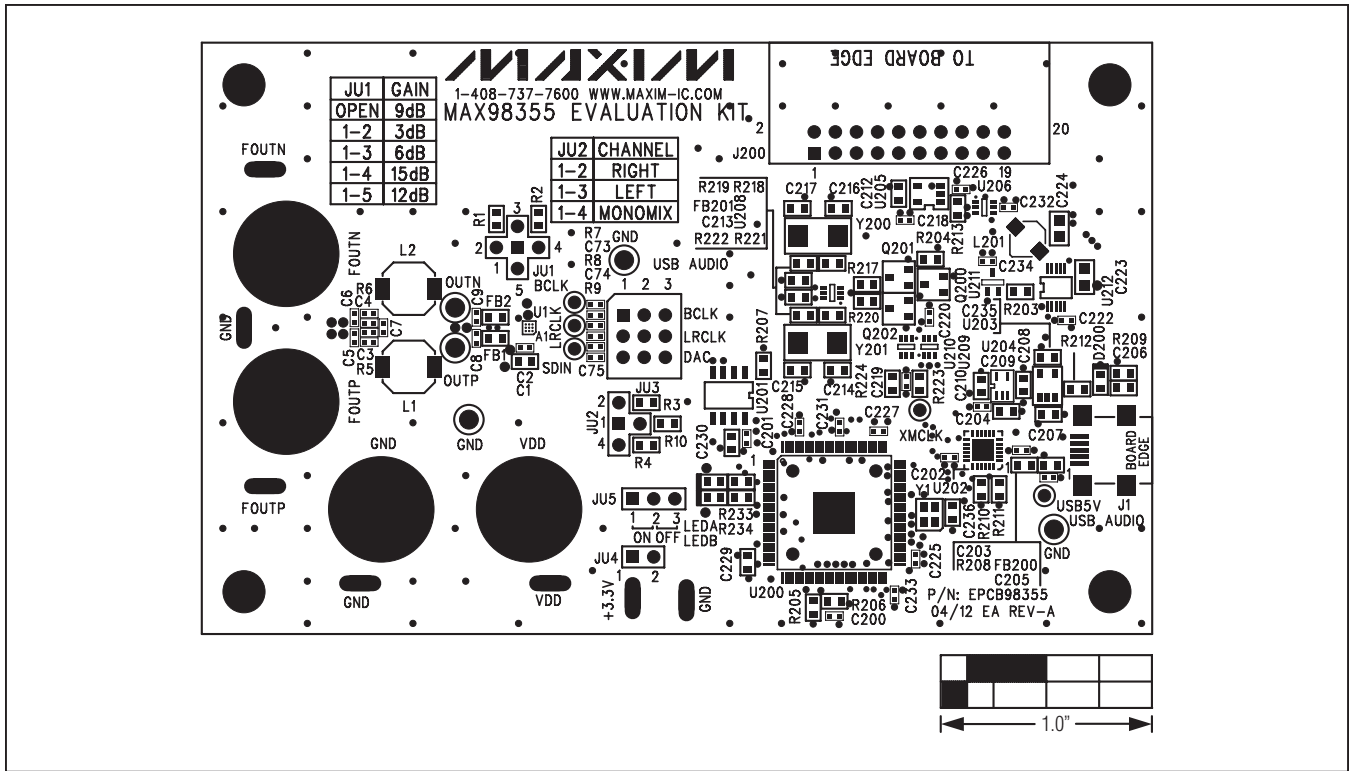
Figure 3. MAX98355 EV Kit Component Placement Guide—Component Side

Figure 4. MAX98355 EV Kit PCB Layout—Component Side
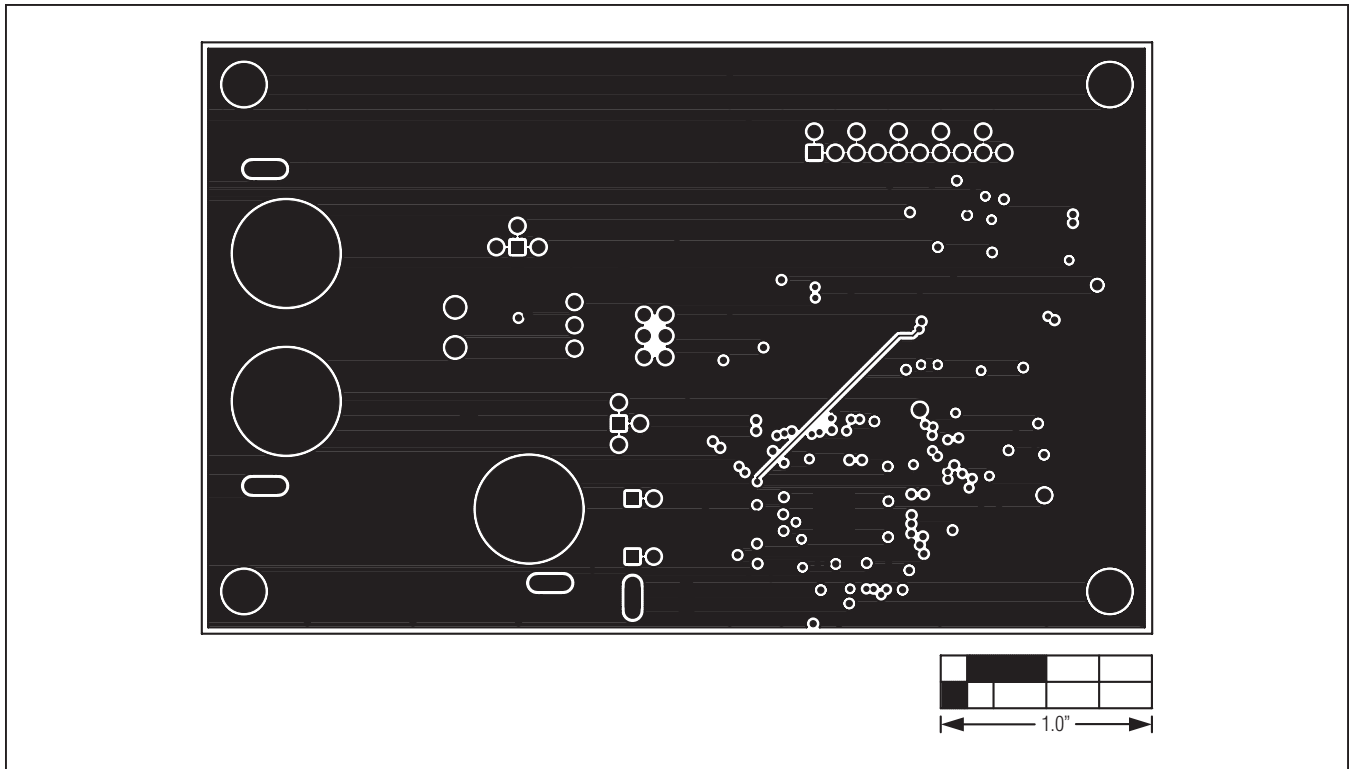
Figure 5. MAX98355 EV Kit PCB Layout—Layer 2
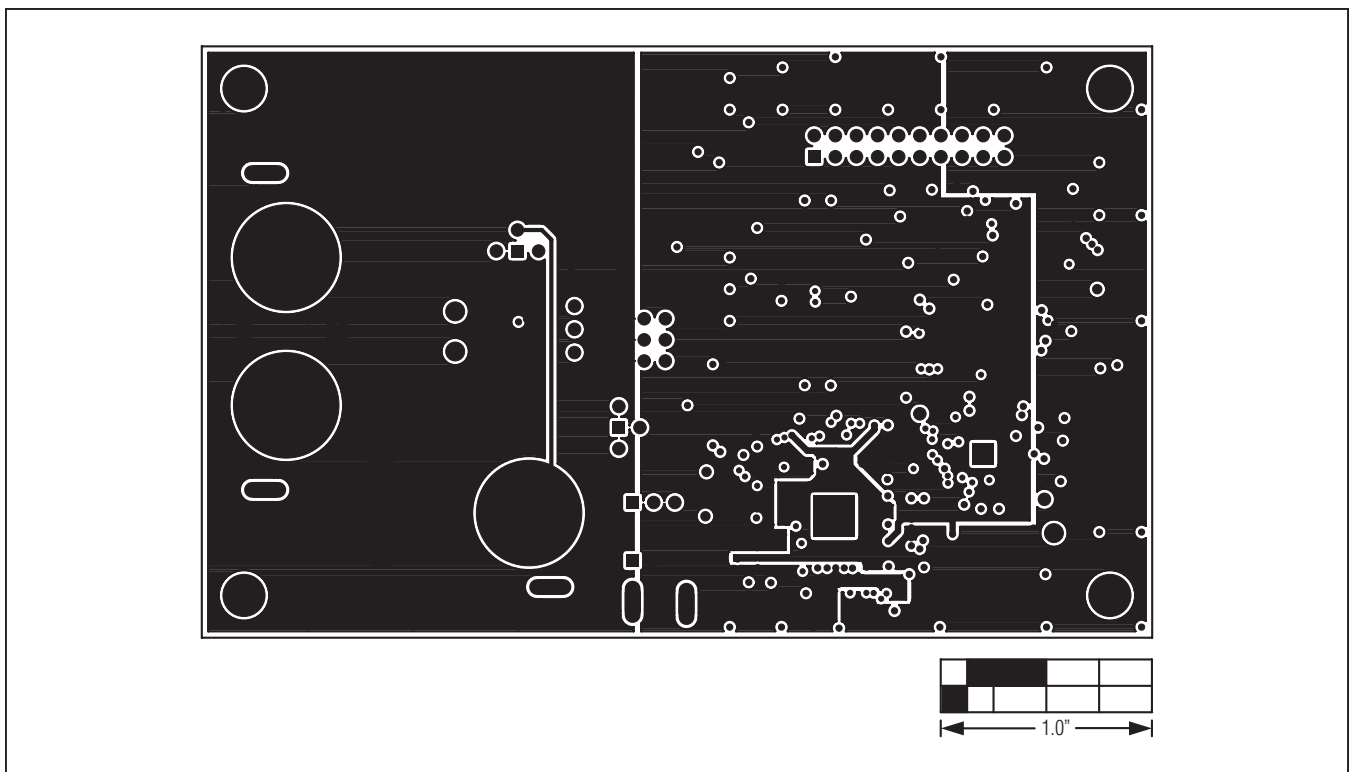
Figure 6. MAX98355 EV Kit PCB Layout—Layer 3

13
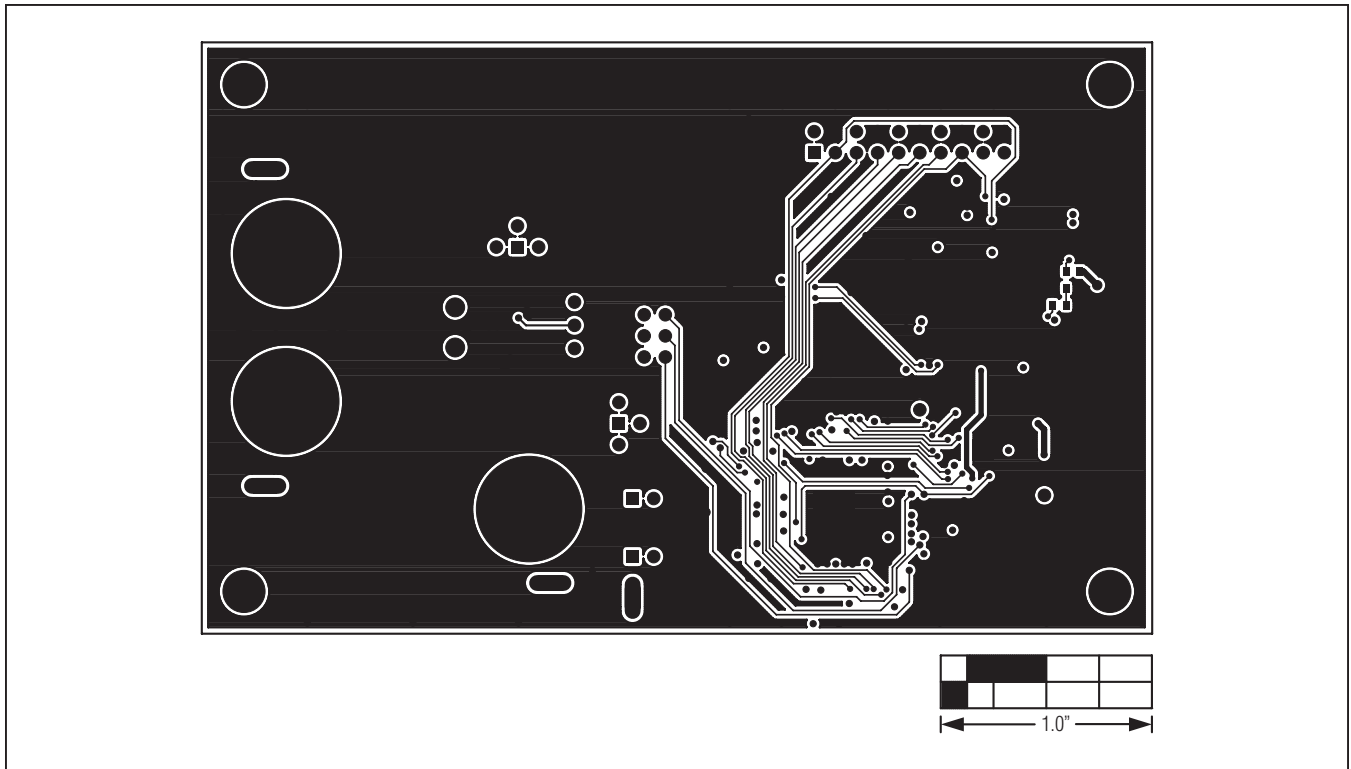
Figure 7. MAX98355 EV Kit PCB Layout—Solder Side
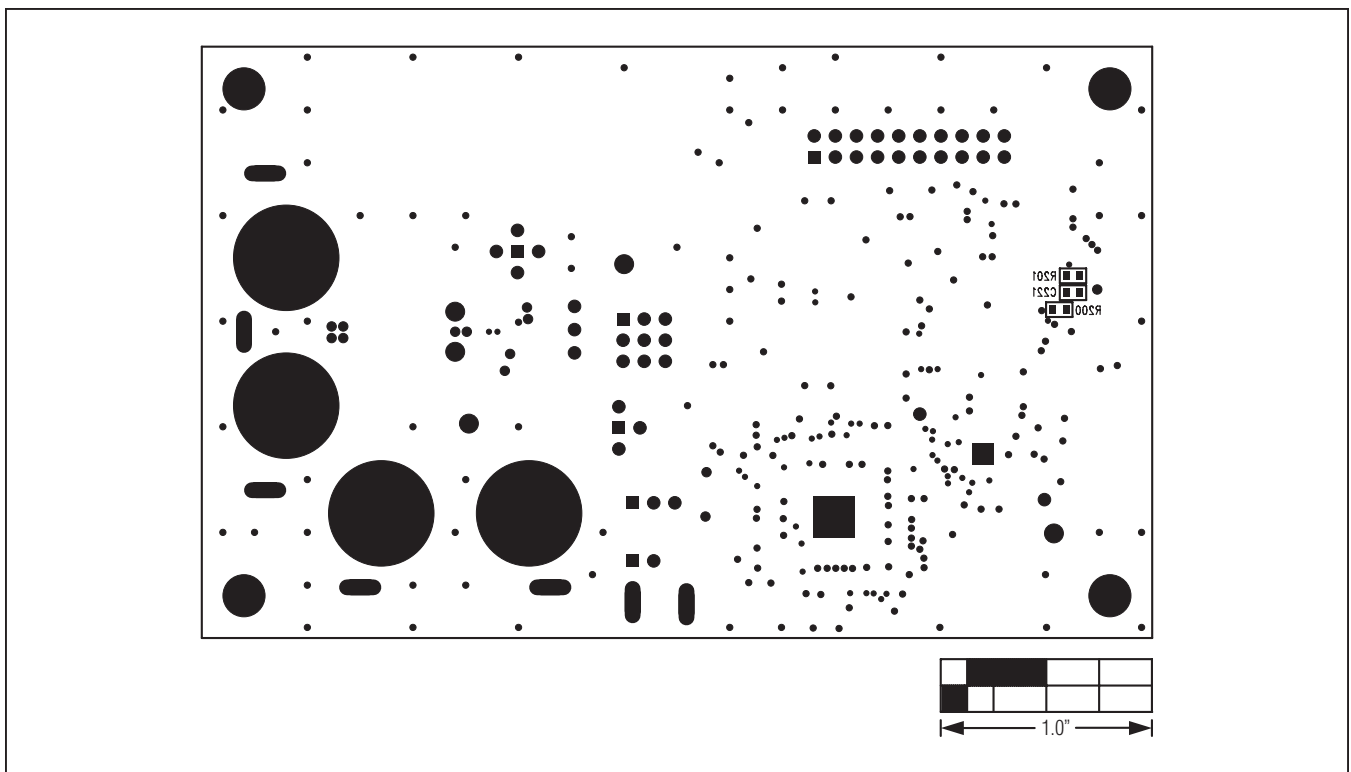
Figure 8. MAX98355 EV Kit Component Placement Guide—Solder Side

Ordering Information

PART	TYPE
MAX98355EVKIT#	EV Kit

#Denotes RoHS compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/12	Initial release	—