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## General Description

The MAX2180A evaluation kit (EV kit) simplifies evaluation of the MAX2180A AM/FM low-noise amplifier. The EV kit enables test of the device features and performance and requires no additional support circuitry or software. The signal input and output use SMA connectors to facilitate connection of RF test equipment.

The EV kit is fully assembled with the device on board and incorporates input matching components for the U.S. FM broadcast band.

## Features

- Easy Evaluation of the MAX2180A
- +6V to +24V Single-Supply Operation
- RF Inputs and Outputs Matched to 50Ω
- Proven PCB Layout
- Fully Assembled and Tested

*Ordering Information appears at end of data sheet.*

## Component List

DESIGNATION	QTY	DESCRIPTION
AMAGC, AMDET, ANTSENSE, FMAGC, FMDET, FMGAIN, LDO, VBATT (x2)	9	Red test points Keystone 5000
AMIN, AMOUT, FMIN, FMOUT	4	SMA connectors Johnson 142-0701-801
C1–C3, C5, C9, C12	6	0.1μF ±10% ceramic capacitors (0603) Murata GRM188R71E104K
C4	1	0.47μF ±10% ceramic capacitor (0603) Murata GRM188R61A474K
C7	1	2700pF ±5% ceramic capacitor (0603) Murata GRM18885C1H272J
C8	1	10μF ±10% tantalum capacitor AVX TAJA106K010R
C10	1	10μF ±10% tantalum capacitor AVX TAJC106K035R
C11	1	100pF ±5% ceramic capacitor (0603) Murata GRM1885C1H101J

DESIGNATION	QTY	DESCRIPTION
C13	1	27pF ±5% ceramic capacitor (0603) Murata GRM1885C1H270J
C30	1	56pF ±5% ceramic capacitor (0603) Murata GRM1885C1H560J
GND	2	Black test points Keystone 5001
L1	1	82nH ±5% inductor (1008) Murata LQW2UAS82NJ00
L5	1	470nH ±5% inductor (0805) TOKO LL2012-FHLR47J
R1, R3, R10, R11	0	Not installed, resistors
R2	1	10kΩ ±5% resistor (0603)
R4	1	43kΩ ±5% resistor (0603)
R5	1	62Ω ±5% resistor (0603)
R6	1	20kΩ ±5% resistor(0603)
R7	1	105Ω ±1% resistor (0603)
R8	1	0Ω ±5% resistor (0603)
R9	1	100kΩ ±5% resistor
R17	1	51Ω ±5% resistor (0603)

**Component List (continued)**

DESIGNATION	QTY	DESCRIPTION
U1	1	AM/FM automotive LNA (24 TQFN-EP*) Maxim MAX2180AETG+
—	5	4-40, 3/16 machine screws McMaster-Carr 91773A105
—	5	4-40, 5/16 machine screws McMaster-Carr 90273A107

DESIGNATION	QTY	DESCRIPTION
—	5	4-40 female standoffs, 1/4in hex x 3/8in McMaster-Carr 91780A163
—	1	Metal heat sink, aluminum base
—	1	PCB: MAX2180A EVALUATION KIT#

\*EP = Exposed pad.

**Component Suppliers**

SUPPLIER	PHONE	WEBSITE
AVX North America	864-967-2150	www.avx.com
Keystone Electronics Corp.	800-221-5510	www.keyelco.com
Murata Americas	800-241-6514	www.murataamericas.com
TOKO America, Inc.	847-297-0070	www.tokoam.com

**Note:** Indicate that you are using the MAX2180A when contacting these component suppliers.

**Quick Start**

**Required Test Equipment**

- RF signal generator (or generators) capable of delivering a signal in the 200kHz to 30MHz (AM) range, or 76MHz to 162.5MHz (FM) range at a power level of -34dBm. (A higher power source is required to measure distortion performance. See the *Measurements* section for more details)
- RF spectrum analyzer that covers the operating frequency range
- DC power supply capable of supplying +6V to +24V
- 50Ω cables with SMA connectors
- Ammeter to measure supply current (optional)
- Noise-figure meter to measure NF (optional)
- Network analyzer to measure gain and return loss (optional)

**Connections and Setup**

**Checking Gain**

The EV kit is fully assembled and factory tested. Follow the steps below for proper device evaluation in the default configuration.

- 1) Connect a DC supply (preset to +10V) to the VBATT and GND terminals (through an ammeter, if desired) on the EV kit.

- 2) Set the RF generator to the desired frequency at a power level of -37dBm. For AM gain measurement, connect the generator output to the AMIN SMA connector on the EV kit. For FM gain measurement, connect the generator output to the FMIN SMA connector on the EV kit.
- 3) For FM gain measurement, connect an SMA cable from the FMOUT SMA connector to the input of the spectrum analyzer. For AM gain measurement, connect an SMA cable from the AMOUT SMA connector to the input of the spectrum analyzer
- 4) Turn on the DC supply. The supply current should read approximately 75mA.
- 5) Activate the RF generator's output. The signal on the spectrum analyzer's display should indicate a typical gain, as shown on the MAX2180A IC data sheet after accounting for cable and board losses.
- 6) Optional: Another method of determining gain is by using a network analyzer. This has the advantage of displaying gain versus a swept frequency band, in addition to displaying input and output return loss. Refer to the user manual of the network analyzer for setup information.



## Detailed Description of Hardware

### Test Points

The MAX2180A has separate FM and AM signal paths, each with its own power detector and AGC loop. The FM and AM signal paths can be separately adjusted for maximum gain and AGC threshold. In addition, the AGC loop can be overridden by applying an external voltage to the AMAGC or FMAGC pins. Table 1 describes how to control the performance of the device using the test points on the EV kit.

AM gain is set by resistor R8. The default value is 0 $\Omega$ , giving 7.5dB (typ) gain. Refer to the MAX2180A IC data sheet for information on AM gain versus the value of R8.

### Measurements

#### AM Gain

Most RF test and measurement equipment is designed to operate in 50 $\Omega$  characteristic impedance. However, the impedance of an automotive AM antenna is much higher than 50 $\Omega$ . To account for this, the EV kit adds an RC network (R17, C30) on the AM input. The 50 $\Omega$  resistor (R17) matches the characteristic impedance of the 50 $\Omega$  RF signal generator, while the 56pF capacitor mimics the high source impedance of the antenna.

#### AM Noise

AM noise at the output can be measured using a spectrum analyzer. The measurement is simplified if the spectrum

analyzer is equipped with a noise marker. Because the noise power at the output is small, a post amplifier might be required.

#### AM Distortion

Two-tone distortion of the AM amplifier can be measured using a power combiner to couple the signals from two generators into AMIN on the EV kit. Because the signal generators can interact, generating distortion products of their own, it is important to provide sufficient isolation between them. One way to do this is using attenuators on the generator outputs.

#### FM Noise

FM noise figure can be measured using a NF meter. Because of the large number of FM broadcast signals that might be present, this measurement should take place with the EV kit in a screen box or other type of RF shield.

#### FM Distortion

Two-tone distortion of the FM amplifier can be measured using a power combiner to couple the signals from two generators into FMIN on the EV kit. During closed-loop operation, as the signal levels increase, the device's FM input impedance is reduced. At the upper end of the input signal level range, where each tone can be greater than 120dB $\mu$ V, this reduced impedance could create distortion within the signal generators. For accurate distortion measurement, the FM input of the EV kit should be isolated from the signal generators and power combiner. This can be accomplished using a ferrite isolator.

**Table 1. Control Performance with Test Points**

TEST POINT	FUNCTION	DESCRIPTION
AMAGC	AM AGC loop control voltage	Applying a DC control voltage to AMAGC allows the user to override the AGC loop. 5V gives maximum gain; 0V gives minimum gain.
AMDET	AM AGC threshold	Sets the AM AGC threshold. Refer to the MAX2180A IC data sheet. Default value on the EV kit is 83dB $\mu$ V (typ) (R11 = open).
ANTSENSE	Antenna sense	Disables the device and sets the supply current to 20mA (typ) if the antenna fault is detected. Refer to the MAX2180A IC data sheet.
FMAGC	FM AGC loop control voltage	Applying a DC control voltage to FMAGC allows the user to override the AGC loop. 0V gives maximum gain; 5V gives minimum gain.
FMDDET	FM AGC threshold	Sets the FM AGC threshold. Refer to the MAX2180A IC data sheet. Default value on the EV kit is 99dB $\mu$ V (typ) (R4 = 43k $\Omega$ ).
FMGAIN	FM gain control	Sets the maximum value of FM gain (FMAGC = 0V). Default setting on the EV kit is 6dB (typ) (R2 = 10k $\Omega$ ).
LDO	Regulated voltage	Allows measurement of internal regulator voltage.

## Layout Considerations

### Electrical

At high-signal-level conditions, the RF currents flowing in the device can induce voltages in the PCB ground plane, known as “ground bounce.” To avoid unwanted spurious products in the signal path due to ground bounce, proper grounding techniques must be followed.

To prevent ground bounce from large FM signals entering the AM signal path, the AM bypass capacitor C3 and AM input resistor R17 must be grounded directly to ground pins 8 and 9.

### Thermal

The device is designed to meet data sheet specifications at supply voltages up to +15V, and to function at supply voltages up to +24V. Under these conditions, a significant amount of power must be dissipated by the circuit. This requires the application PCB to provide a low thermal impedance path to a thermal ground.

The EV kit PCB design accounts for this by providing an array of thermal vias in the ground plane and a wide top metal trace connecting the package pad to a nearby screw. Adjacent pins 20–23 are all grounded, which allows the wide trace.

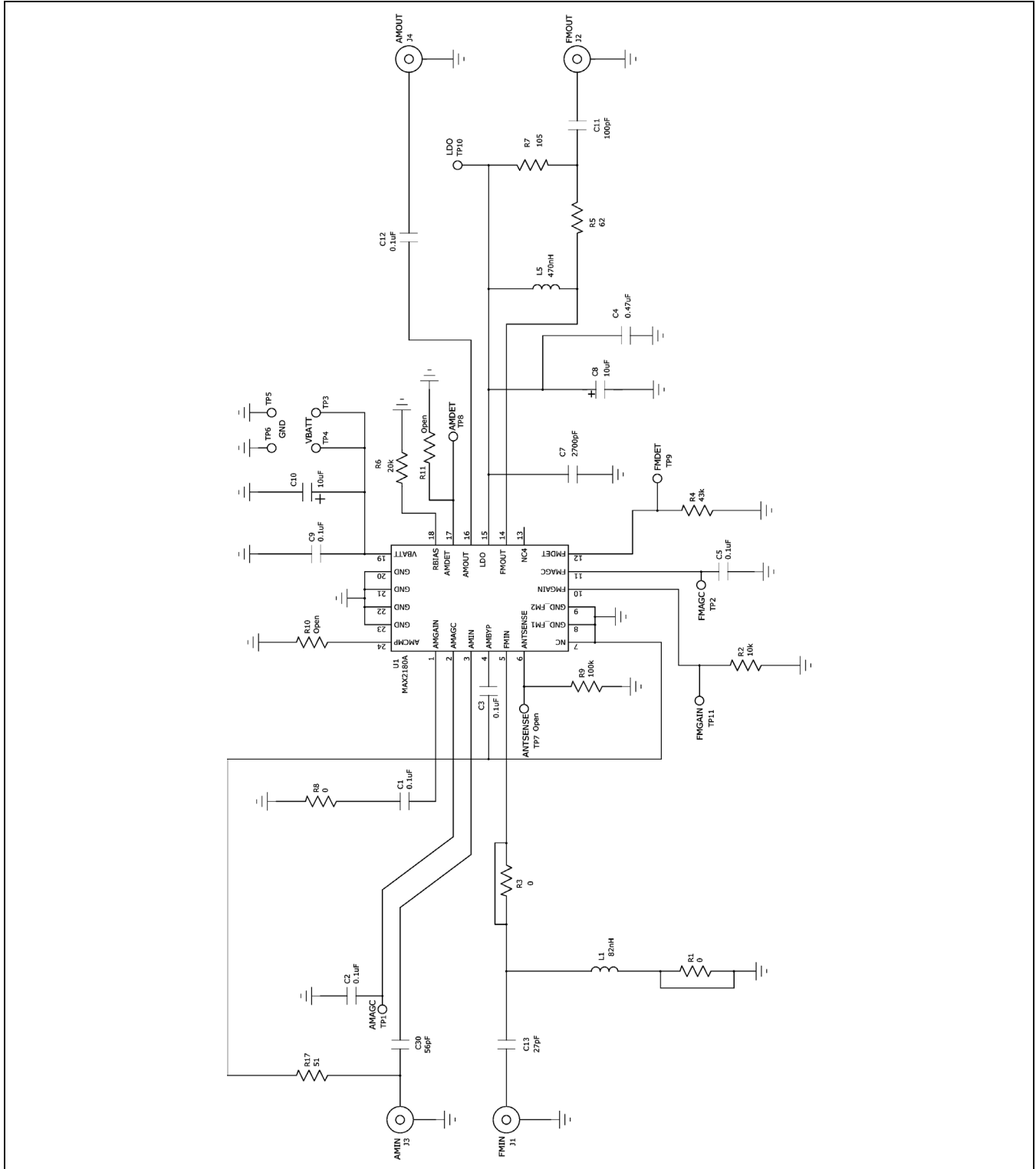


Figure 1. MAX2180A EV Kit Schematic

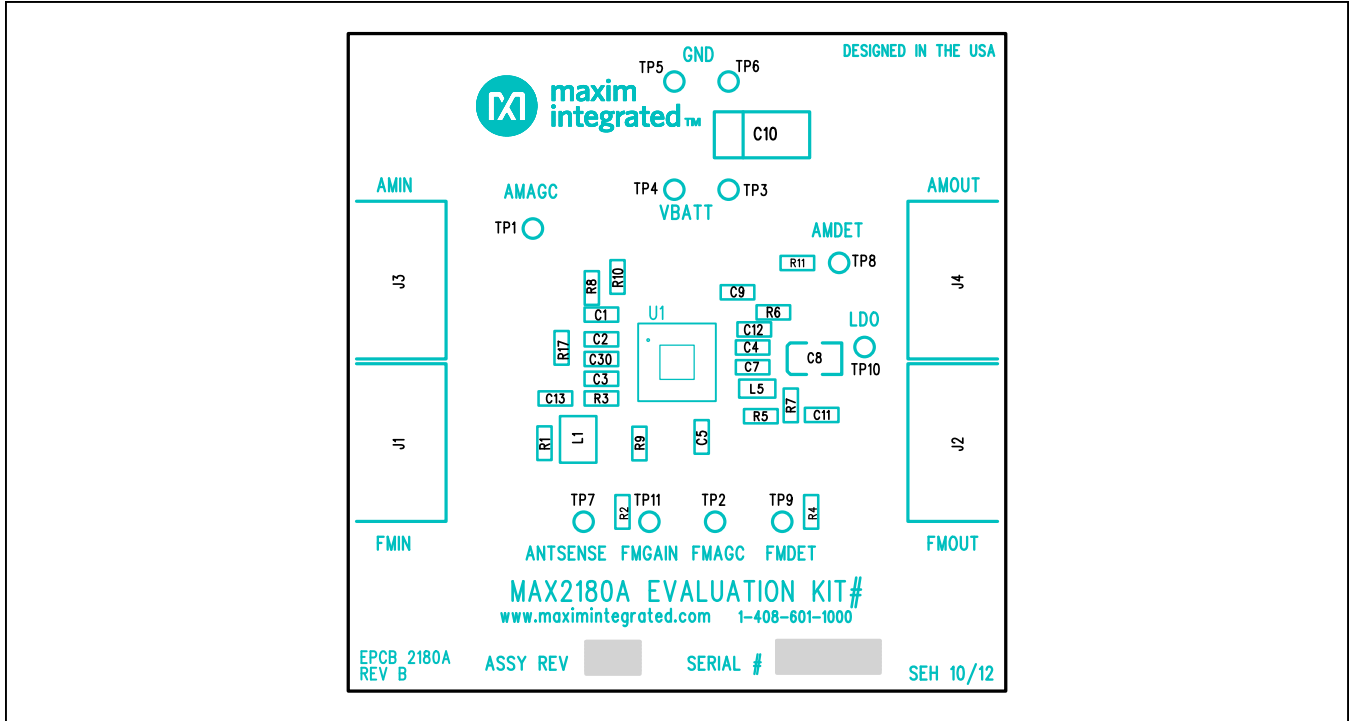


Figure 2. MAX2180A EV Kit Component Placement Guide—Top Silkscreen

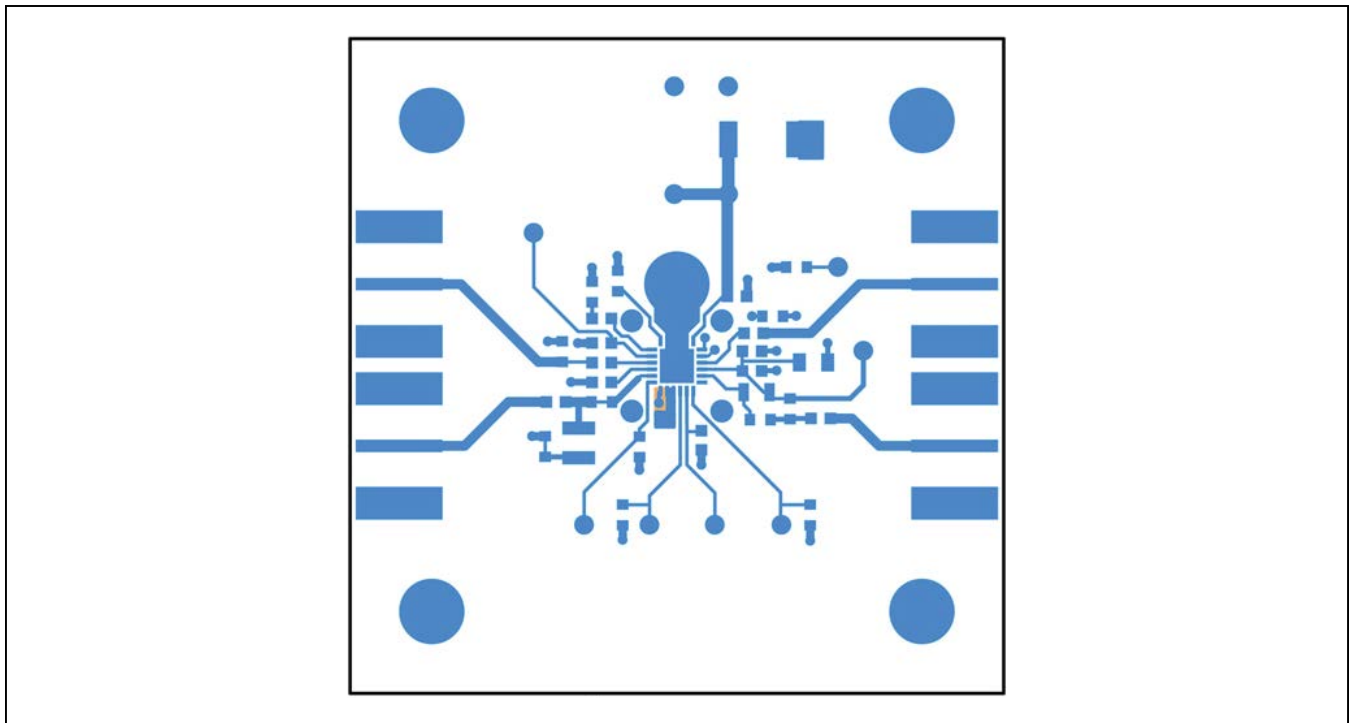


Figure 3. MAX2180A EV Kit PCB Layout—Top Copper

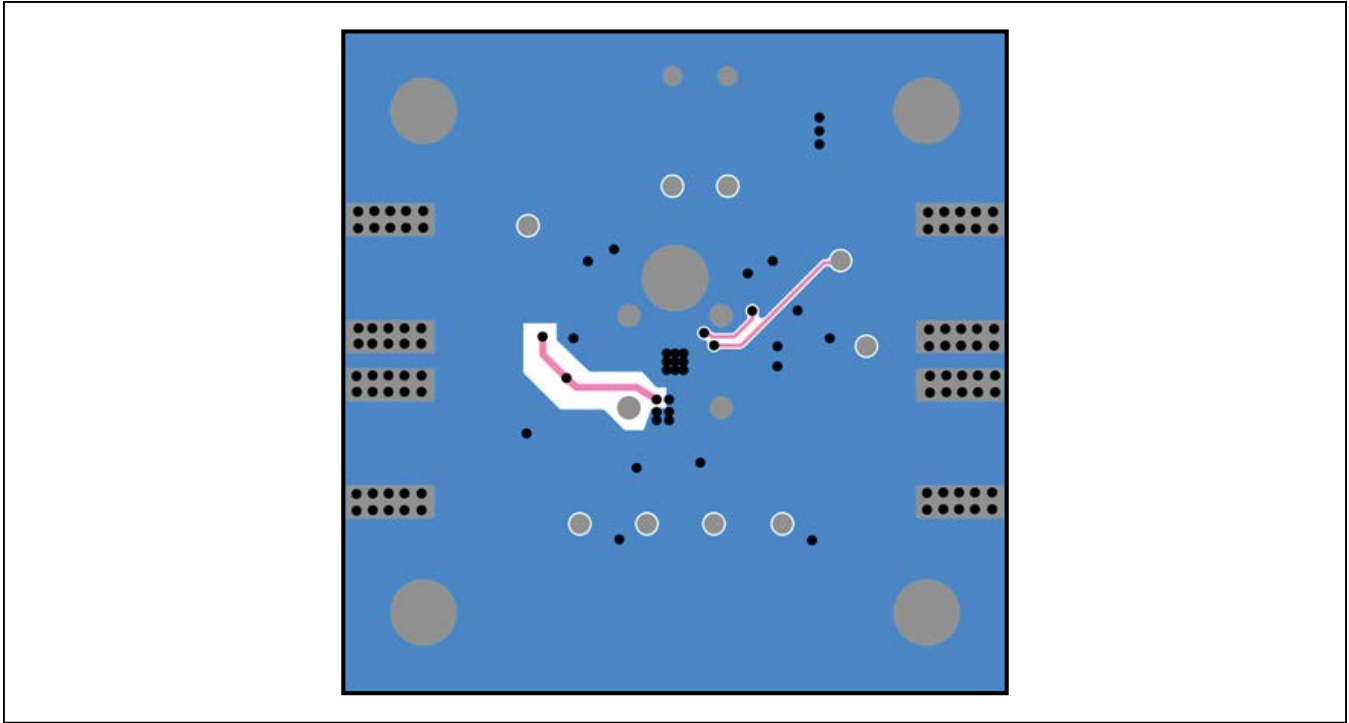


Figure 4. MAX2180A EV Kit PCB Layout—Bottom Copper



### Ordering Information

PART	TYPE
MAX2180AEVKIT#	EV Kit

#Denotes RoHS compliant.

### Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	4/13	Initial release	—

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