19-5289; Rev 0; 5/10

MAX3544 Evaluation Kit

Evaluates: MAX3544

General Description

The MAX3544 evaluation kit (EV kit) simplifies the testing and evaluation of the MAX3544 digital television tuner. The EV kit is fully assembled and tested at the factory. Standard 50Ω SMA connectors are included on the EV kit for the inputs and outputs to allow quick and easy evaluation on the test bench.

This document provides a list of equipment required to evaluate the device, a straightforward test procedure to verify functionality, a description of the EV kit circuit, the circuit schematic, a list of components for the EV kit, and artwork for each layer of the PCB.

Features

- **Easy Evaluation of the MAX3544**
- **50Ω SMA Connectors**
- **All Critical Peripheral Components Included**
- **Fully Assembled and Tested**
- **PC Control Software**

Ordering Information

PART	TYPE
MAX3544EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C0	1	8.2pF ±0.1pF capacitor (0402) Murata GRM1555C1H8R2B
C1	1	1µF ±10% capacitor (0402) Murata GRM155R61A105K
C2–C5, C10, C12, C13, C15, C19, C25, C32–C35, C44, C45, C100, C101	18	1000pF ±10% capacitors (0402) Murata GRM155R71H102K
C6, C8	2	39pF ±5% capacitors (0402) Murata GRM1555C1H390J
C7	1	2pF ±0.1pF capacitor (0402 Murata GRM1555C1H2R0B
C9	1	47µF ±10% capacitor (1210) Murata GRM32CR61A476K
C11	1	4.7pF ±0.1pF capacitor (0402) Murata GRM1555C1H4R7B
C14, C23, C29, C31, C36, C60	0	Not installed, ceramic capacitors (0402)
C16	1	0.01µF ±10% capacitor (0402) Murata GRM155R71E103K
C17	1	5.6pF ±0.1 capacitor (0402) Murata GRM1555C1H5R6B
C18	1	10µF ±10% tantalum capacitor (2012) (Rcode/case 0805 compatible) AVX TAJR106K006
C20	1	0.47µF ±10% capacitor (0402) Murata GRM155R61A474K
C21	1	1500pF ±10% capacitor (0402) Murata GRM155R71H152K
C22	1	33000pF ±10% capacitor (0402) Murata GRM155R71A333K
C24, C26, C30	3	22pF ±5% capacitors (0402) Murata GRM1555C1H220J
C28	1	Not installed, ceramic capacitor (0603)
C37	1	100pF ±5% capacitor (0402) Murata GRM1555C1H101J
C38, C39	2	47pF ±5% capacitors (0402) Murata GRM1555C1H470J
C40	1	120pF ±5% capacitor (0402) Murata GRM1555C1H121J
C41, C42	2	56pF ±5% capacitors (0402) Murata GRM1555C1H560J
C43	1	180pF ±5% capacitor (0402) Murata GRM1555C1H181J
C61	1	0.1µF ±10% capacitor (0603) Murata GRM188R71E104K
DTV, JP3, JP4, JP5, JP7	5	Single in-line headers, 100 mil centers Sullins PEC36SAAN
GND, GND1, GND2	3	PC mini (black) test points Keystone 5001

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.

MAX3544 Evaluation Kit

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
IFVGC, RFVGC	2	PC mini (white) test points Keystone 5002
J1, J3	2	SMA end-launch jack receptacles, 0.062in Emerson (Johnson) 142-0701-801
J2, J5, J6	0	Not installed, SMA end-launch jacks
JP2	1	Dual in-line header, 100 mil centers Sullins PEC36DAAN
JP6, REFOUT	0	Not installed, 2-pin headers
L0, L1	2	15nH ±5% inductors (0603) Murata LQG18HN15J00
L2	1	68nH ±5% inductor (0603) Murata LQG18HN68NJ00
L3	1	150nH ±5% inductor (0603) TOKO LL1608-FSLR15J
L4, L7	2	270nH ±5% inductors (0603) TOKO LL1608-FSLR27J
L5	1	12nH ±5% inductor (0603) Murata LQG18HN12NJ00
L6	1	18nH ±5% inductor (0603) Murata LQG18HN18NJ00
L8	1	47nH ±5% inductor (0603) Murata LQG18HN47NJ00
L9, L11	0	Not installed, inductors (0603)
L12	1	180nH ±5% inductor (0603) TOKO LL1608-FSLR18J
L13	1	120nH ±5% inductor (0603) TOKO LL1608-FSLR12J
L14	1	100nH ±5% inductor (0603) TOKO LL1608-FSLR10J
R0	1	560Ω ±5% resistor (0402)
R1, R3, R5, R6, R14–R17, R20, R22	0	Not installed, resistors (0402)
R2, R23	2	390Ω ±1% resistors (0402)
R4, R8	2	1kΩ ±1% resistors (0402)
R7	1	442Ω ±1% resistor (0402)
R9, R18, R24	3	100Ω ±5% resistors (0402)
R10	1	86.6Ω ±1% resistor (0402)
R11	1	43.2Ω ±1% resistor (0402)
R19, R21, R28, R29, R42, R50, R54–R59, R61–R64	16	0Ω ±5% resistors (0402)
R25	1	348Ω ±1% resistor (0402)
R49	1	910Ω ±5% resistor (0402)
R53	1	15Ω ±5% resistor (0402)
R60	1	600Ω ±25% ferrite bead (0402) Murata BLM15AG601SN1
SCL, SDA, VTUNE	0	Not installed, ST single male headers
T1	1	Balun (4:1 impedance ratio) TOKO #617PT-1664
T8	0	Not installed, balun
U1	1	Multiband digital television tuner (40 TQFN-EP*) Maxim MAX3544CTL+
VCC, VDD	2	PC mini (red) test points Keystone 5000
Y1	0	Not installed, 16MHz crystal
Y2	1	16MHz crystal (HC49/U) Suntsu SCX331-16.000MHz
—	2	2-position shorting jumpers (JP3, JP5), 0.1in center Kycon SX1100-B
—	1	INTF3000+ interface board with ribbon cable
—	1	PCB: MAX3543 EVALUATION KIT+

**EP = Exposed pad.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
AVX Corporation	843-946-0238	www.avx.com
Emerson Network Power	507-833-9922	www.emersonnetworkpower.com
Keystone Electronics Corp.	209-796-2032	www.keyelco.com
Kycon, Inc.	408-494-0330	www.kycon.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Sullins Electronics Corp.	760-744-0125	www.sullinselectronics.com
Suntsu Frequency Control	949-305-0220	www.suntsuinc.com
TOKO America, Inc.	847-297-0070	www.tokoam.com

Note: *Indicate that you are using the MAX3544 when contacting these component suppliers.*

Quick Start

The MAX3544 EV kit is fully assembled and factory tested. Follow the instructions in the *Connections and Setup* section for proper device evaluation.

Test Equipment Required

- Power supply capable of supplying at least 300mA, +3.3V
- RF signal generator capable of delivering at least 0dBm of output power at the operating frequency
- RF spectrum analyzer capable of covering the operating frequency range of the device
- 50Ω SMA cables
- User-supplied PC with Windows XP® or later operating system and an available USB port
- USB cable with USB-A male connector on one end and USB-B male connector on the other end
- (Optional) Dual-output power supply capable of supplying up to 3V at < 1mA (to apply gain control voltages directly).
- (Optional) Ammeter to measure supply current

Connections and Setup

This section provides a step-by-step guide to testing the basic functionality of the EV kit in DVB-T mode. **Caution: Do not turn on DC power or RF signal generators until all connections are completed.**

1) Connect the provided 20-pin ribbon cable between the INTF3000+ board (J1 labeled as INTF2400) and the EV kit JP2 connector. Make sure that pin 1 of the INTF3000+ board J1 connector is connected to pin 1 of the EV kit JP2 connector.
2) Make sure that jumper JU1 on the INTF3000+ board is in the VDEV position. Verify that J6 and J7 jumpers are not present.
3) Connect the USB cable between the PC's USB port and the INTF3000+ board. The red light on the INTF3000+ board should light once briefly when the board is connected to the PC. It also blinks periodically as the IC's software communicates with the board.
4) Verify that jumpers JP3 and JP5 are installed on the EV kit.
5) With its output disabled, set the DC power supply to +3.3V. Connect the power supply to the VCC (through an ammeter if desired) and GND terminals on the EV kit. If available, set the current limit to 300mA.
6) With its output disabled, connect the output of the RF signal generator to the SMA connector labeled RFIN (J1) on the EV kit.
7) Connect the IFOUT_DTV output (J3) to a spectrum analyzer.
8) Turn on the +3.3V power supply. The supply current should read approximately 260mA. If an ammeter is used, be sure to adjust the power supply to account for any voltage drop across the ammeter.
9) Install the IC control software provided by Maxim.
10) Maxim also provides a FactorySettings.ini file that includes predefined IC register configurations for different TV standards (DVB-T, DVB-C, etc.). Manually copy the FactorySettings.ini file into the directory where the IC control software is installed. The path should be "C:\Program Files\MAX3544\" or similar.

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11) Launch the IC control software.

12) Verify that the I²C write address setting in the EV kit software (Options → I²C Write Address menu item) matches the EV kit hardware configuration. By default, the EV kit comes with no jumper installed on the JP4 header. This corresponds to the address setting of 0xC2.

13) Verify that the software shows Board/USB-Online in a green box at the bottom of the window. If the status is OFFLINE-Click Here, then verify all the connections described above in steps 1 through 8.

14) Go to the Options → External IF Bandpass Filter menu item and select the IF bandpass filter used at the IFOUT1 output on the EV kit. Most of the EV kits use a differential LC filter. It is important to select the appropriate mode to ensure that the right IFOUT1 output driver (differential vs. single-ended) is used to drive the bandpass filter.

15) Go to the Synth tab and set the REF FREQ to match the crystal frequency (in MHz) on the EV kit. Most of the EV kits use 16MHz crystals.

16) Set the IF FREQ to the desired value. Note that the on-chip bandpass filter is centered at 36.15MHz, so the IF FREQ should be set within ±0.2MHz of 36.15MHz.

17) Load the predefined factory settings to set the IC registers to receive the desired TV standard. For instance, to configure the IC for reception of DVB-T signals, choose the Factory Settings → DVB-T menu item. Note that Maxim provides predefined configurations for most of the existing TV standards. If custom optimization is desired, use these settings as a starting point.

Gain Measurement to the IFOUT_DTV Port in DVB-T Mode

1) Connect the dual-output power-supply outputs to the RFVGC and IFVGC terminals on the EV kit. Adjust voltages at RFVGC and IFVGC to be approximately +3V.

2) Load the predefined factory settings for DVB-T mode by selecting the Factory Settings → DVB-T menu item.

3) Enter the desired RF frequency (e.g., 666MHz) into the RF FREQ text box in the RF Top tab.

4) Verify that the IC has locked to the correct frequency by checking the LOCK light in the bottom-right corner of the window. A green light indicates a successful lock.

5) Set the RF signal generator to a 666MHz frequency and a -90dBm power level. Enable the RF signal generator's output.

6) Set the center frequency of the spectrum analyzer to 36.15MHz and the span to 1MHz. Set the reference level to 0dBm. Increase the input power of the signal generator until the output level reaches -22dBm. This is the output level that corresponds to approximately $1V_{P-P}$ output across the IC's DTVOUT+ and DTVOUT- pins. The voltage gain of the receiver can be calculated by taking the difference in dB between the input and output power and applying correction factors to compensate for the 50Ω to 75Ω min loss pad at the input (R10 and R11), T1 balun (4:1 impedance ratio), and R7 442Ω series resistor at the output.

   Voltage gain can be calculated from:

$$A_V = 3.96dB + 20\ LOG(V_{OUT,RMS}/V_{IN,RMS}) + 6dB + 19.86dB$$

or

$$A_V = (P_{OUT} - P_{IN}) + 29.82dB$$

   where:

   3.96dB is the voltage loss due to the input min loss pad,

$$V_{IN,RMS} = \sqrt{50 \times 10\left(\frac{P_{IN}(dBm) - 30}{10}\right)}$$

   is the input RMS voltage calculated from the input power P_{IN} (i.e., power from the RF signal generator), and

$$V_{OUT,RMS} = \sqrt{50 \times 10\left(\frac{P_{OUT}(dBm) - 30}{10}\right)}$$

   is the output RMS voltage calculated from the output power P_{OUT} (i.e., power at the spectrum analyzer input), 6dB is the output transformer voltage ratio, 19.86dB (i.e., 20 LOG(492/50)) is the voltage loss due to the R7 series resistor.

   The calculated voltage gain should be approximately 85dB.

RF Gain-Control Range (RFVGC)

To measure the gain-control range in the RF stage, follow the steps below:

1) Set RFVGC to +3V.

2) Set IFVGC to +3V.

3) Adjust the RF input power to achieve -22dBm at the IFOUT_DTV output. Record this as the reference output level.
4) Set RFVGC to +0.5V and record the change in the IFOUT_DTV output level in dB relative to -22dBm. This change in output power is the gain-control range of the RF stage.
5) The RF gain-control range is approximately 53dB.
6) Note that it might be necessary to increase the input power level with RFVGC = +0.5V in order to make an accurate level measurement. If this is necessary, calculate the RF gain-control range by first calculating the gain with RFVGC = +3V, then calculate the gain with RFVGC = +0.5V and take the difference between these two gain levels.

IFVGA Gain-Control Range (IFVGC)

To measure the gain-control range in the IFVGA stage, follow the steps below:

1) Set RFVGC to +1V.
2) Set IFVGC to +3V.
3) Adjust the RF input power to achieve -40dBm at the IFOUT_DTV output. Record this as the reference output level.
4) Set IFVGC to +0.5V and record the change in the IFOUT_DTV output level in dB relative to -40dBm. This change in output power is the gain-control range of the IFVGA stage.
5) The IFVGA gain-control range should be approximately 42dB.
6) Note that it might be necessary to increase the input power level with IFVGC = +0.5V in order to make an accurate level measurement. If this is necessary, calculate the IFVGA gain-control range by first calculating the gain with IFVGC = +3V, then calculate the gain with IFVGC = +0.5V and take the difference between these two gain levels.

Connecting the MAX3544 to Digital TV Demodulators

The EV kit includes additional input and output connectors to allow for quick and easy evaluation of the IC's performance with digital TV demodulators. The differential input of the digital demodulator can be connected to the DTV 3-pin header on the EV kit. The IFAGC output of the demodulator should be connected to the IFVGC terminal on the EV kit. The IC controls its RF gain autonomously, so the RFVGC terminal of the EV kit should be left unconnected.

The IC also provides the buffered reference clock output that can be used by demodulators. Use the REFOUT 2-pin header to connect the clock output to the demodulator reference clock inputs.

Layout Considerations

Contact Maxim to obtain the MAX3544 reference design layout to use as a starting point for PCB designs. Refer to the *Layout Recommendations* section in the MAX3544 IC data sheet for more information.

MAX3544 Evaluation Kit

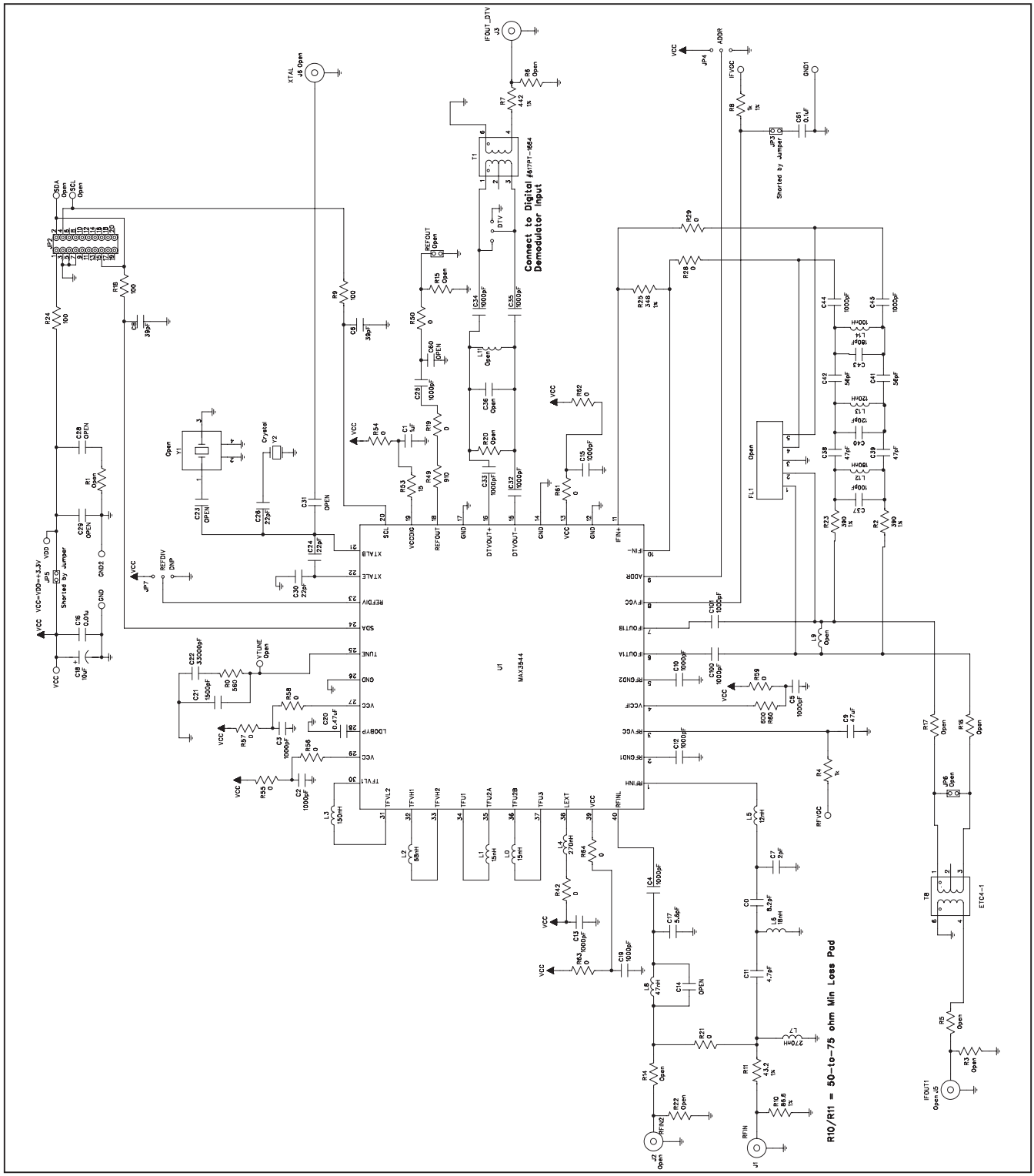


Figure 1. MAX3544 EV Kit Schematic

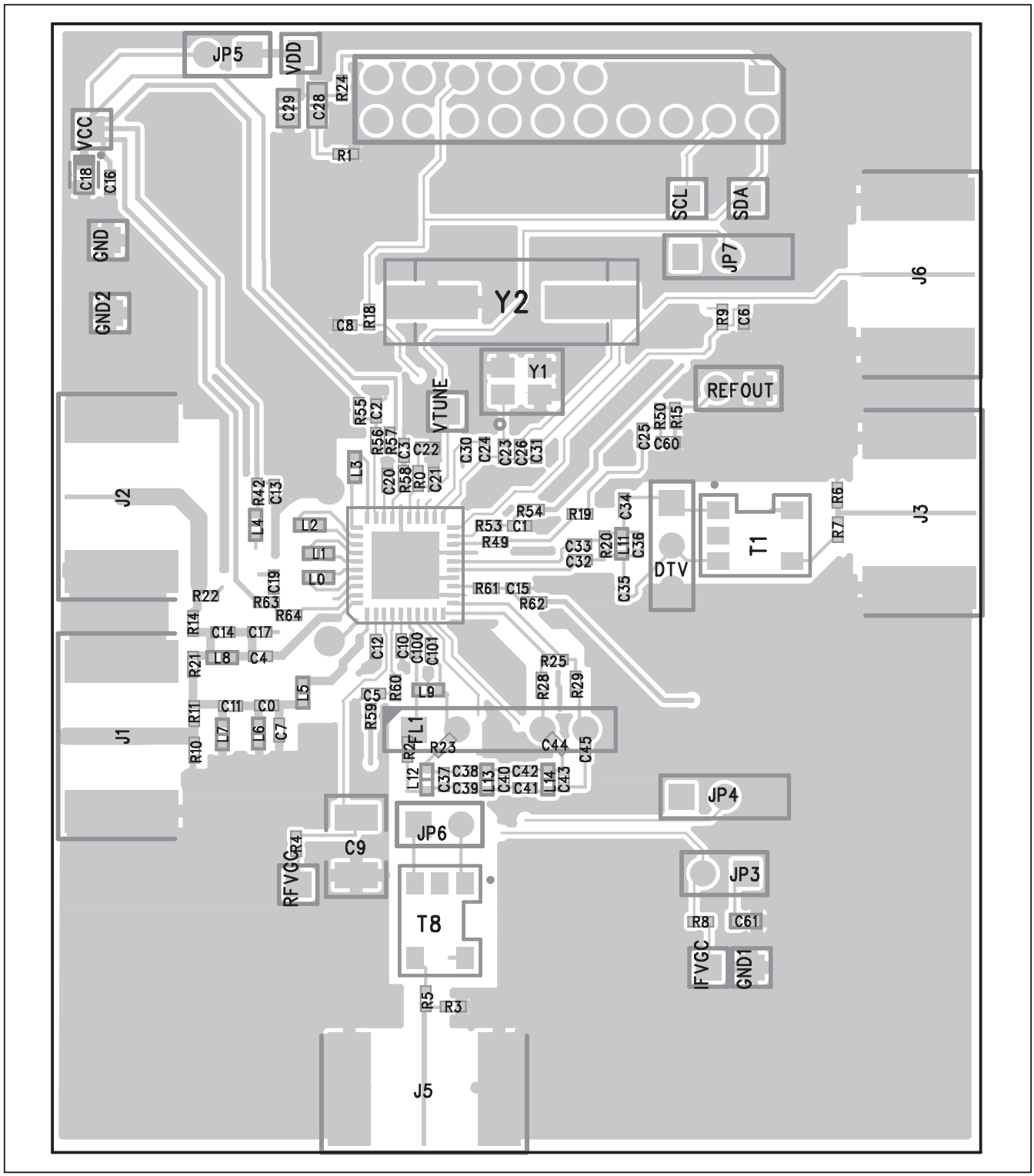


Figure 2. MAX3544 EV Kit Component Placement Guide—Component Side

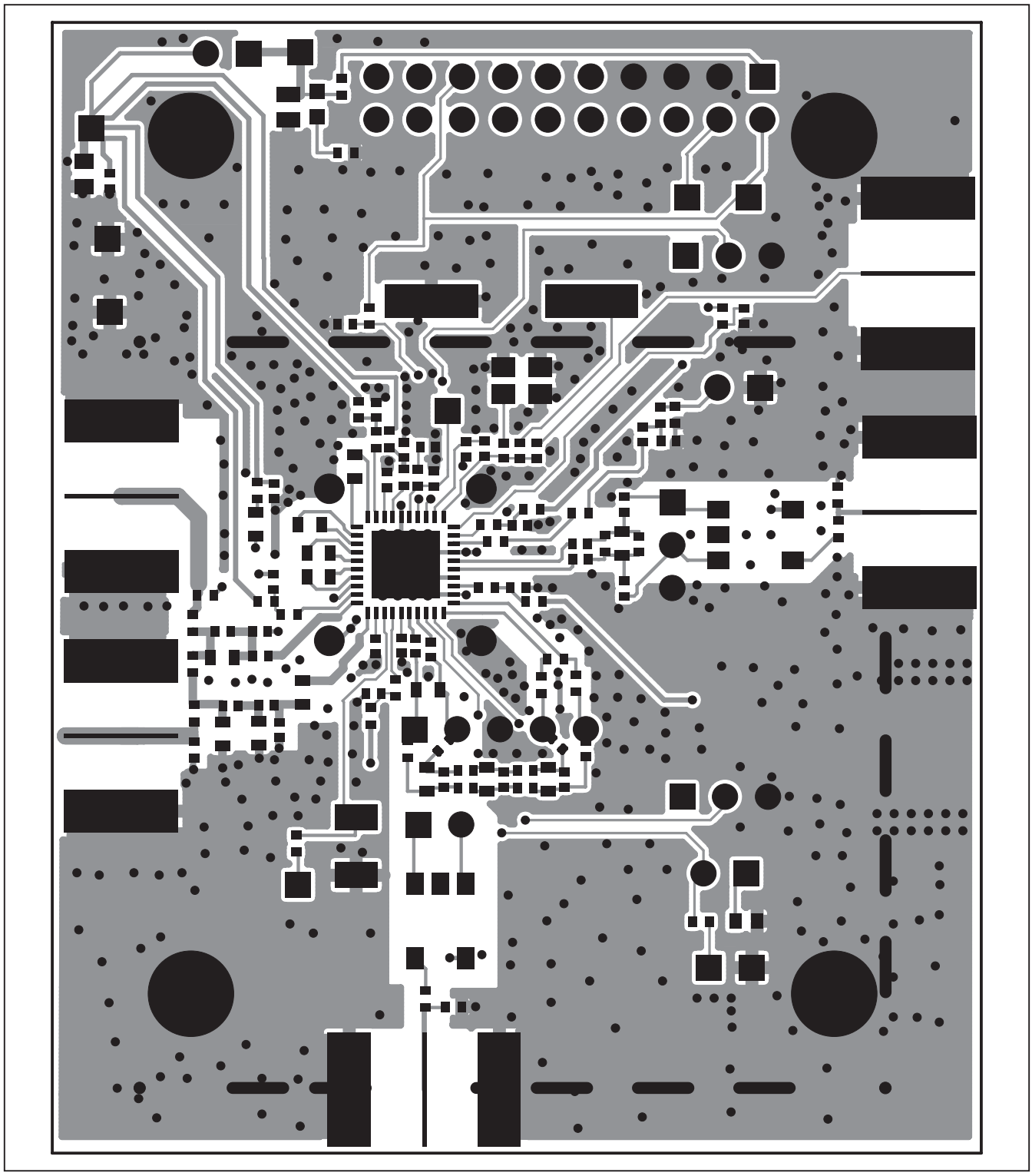


Figure 3. MAX3544 EV Kit PCB Layout—Primary Component Side

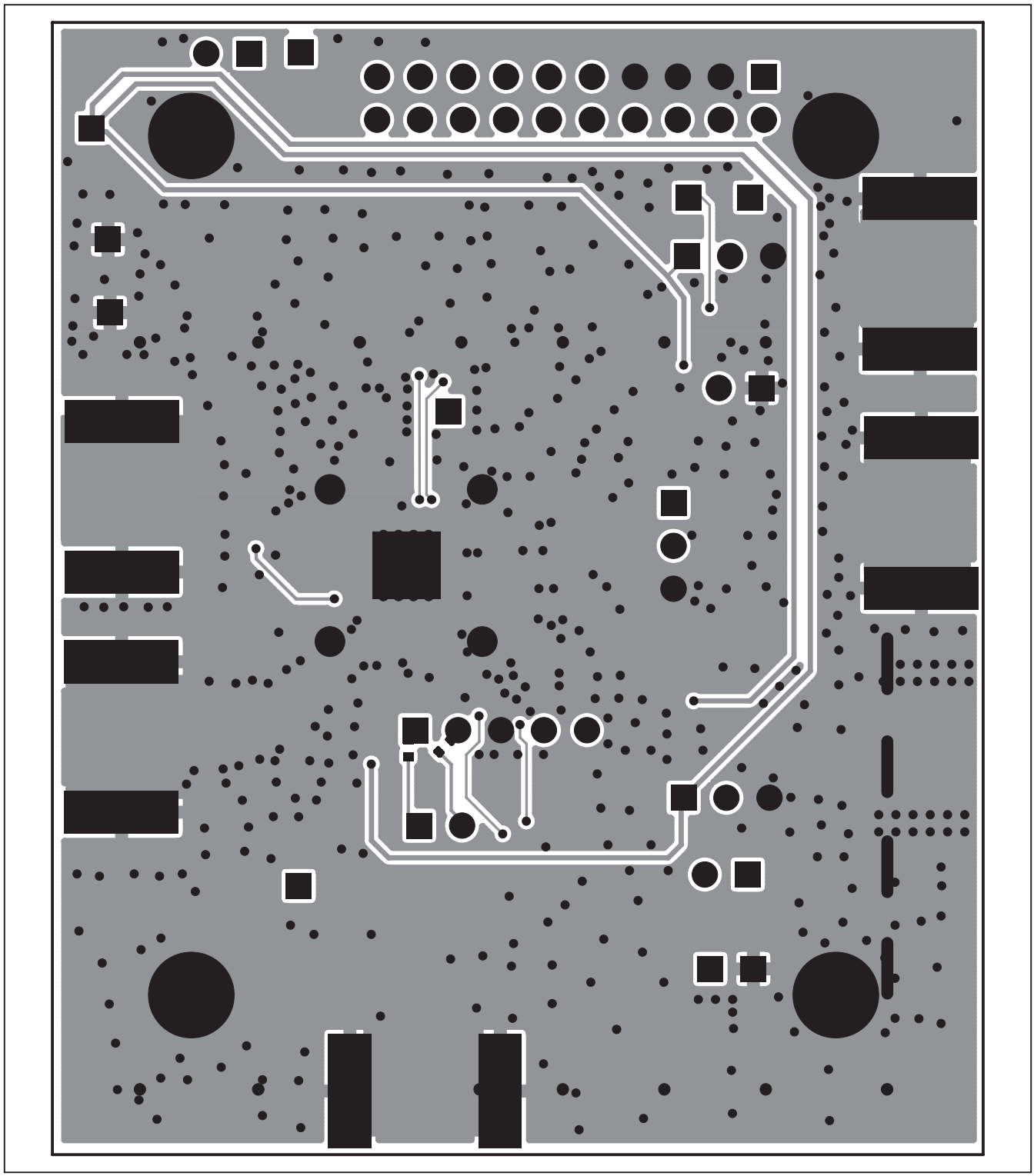


Figure 4. MAX3544 EV Kit PCB Layout—Secondary Component Side

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/10	Initial release	—

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