19-0711; Rev 0; 12/06

MAX2170 Evaluation Kit

Evaluates: MAX2170

General Description

The MAX2170 evaluation kit (EV kit) simplifies evaluation of the MAX2170 direct-conversion to low-IF tuner. It enables testing of the device's performance and requires no additional support circuitry. Standard 50Ω SMA and BNC connectors are included on the EV kit for the inputs and outputs to allow quick and easy evaluation on the test bench. The EV kit is fully assembled and tested at the factory.

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 bill of materials (BOM) for the kit, and artwork for each layer of the PCB.

Features

- **Easy Evaluation of the MAX2170**
- **+2.7V to +3.5V Single-Supply Operation**
- **50Ω SMA Connector on the RF Ports**
- **50Ω BNC Connector for the Baseband Output**
- **Jumpers for Automatic Gain Control**
- **All Critical Peripheral Components Included**
- **Parallel Port for I²C Interfacing**
- **PC Control Software Available at www.maxim-ic.com**

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX2170EVKIT+	-40°C to +85°C	40 QFN-EP*

+Denotes a lead-free and RoHS-compliant EV kit.
**EP = Exposed paddle.*

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	18pF ±5% capacitor (0402) Murata GRM1555C1H180J
C2, C6, C46, C47, C71, C72, C73	7	330pF ±10% capacitors (0402) Murata GRM155R71H331K
C3, C14, C17	3	1.0µF ±10% capacitors (0402) Murata GRM155R60J105K
C4	1	100µF ±20% capacitor (1210) AVX 1210D107MAT
C5	1	4.7µF ±20% capacitor (0805) Murata GRM21BF51A475Z
C7, C18, C22, C38, C39, C41	6	1000pF ±5% capacitors (0402) Murata GRM1555C1H102J
C8, C13, C16, C20, C28, C29	6	0.01µF ±10% capacitors (0402) Murata GRM155R71C103K
C9, C10, C15, C19, C21, C31, C40, C42, C44, C45, C75	11	0.1µF ±10% capacitors (0402) Murata GRM155R61A104K
C11, C12	2	0.33µF ±10% capacitors (0603) Murata GRM155R60J334K

DESIGNATION	QTY	DESCRIPTION
C23	1	100pF ±5% capacitor (0402) Murata GRM1555C1H101J
C24, C25, C26, C30, C32–C37, C43, C48	0	Not installed, capacitors
C27	1	33pF ±5% capacitor (0402) Murata GRM1555C1H330J
C76	1	10µF ±10% tantalum capacitor (C-case) AVX TAJC106K016
D1	1	Super-mini Schottky diode Central Semi CMDSH2-3 (lead free)
J1	1	BNC 50Ω vertical mount A/D Electronics 580-002-00
J2	0	Not installed
J3, J4	2	SMA end-launch jack receptacles, 0.062in Johnson 142-0701-801
J13	1	DB25 right-angle male connector AMP 5747238-4
JP1	0	Not installed

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

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
JP3	1	1 x 2 in-line header, 100-mil center Sullins PEC36SAAN
JP4, JP10	2	1 x 3 in-line headers, 100-mil center Sullins PEC36SAAN
L1	1	Not installed
L3, L4	2	91nH ±5% inductors (0603CS) Murata LQW18AN91NJ00
Q1, Q2, Q3	3	NPN 1GHz wideband transistors Philips BFS17W
R1	1	270Ω ±5% resistor (0402)
R2, R6	2	1kΩ ±1% resistors (0402)
R3, R9–R12, R18, R41, R42	8	100Ω ±5% resistors (0402)
R4, R5	2	2kΩ ±1% resistors (0402)
R7, R35, R39	3	12kΩ ±5% resistors (0402)
R8, R37, R46, R47	4	2.7kΩ ±5% resistors (0402)
R13	1	27.4kΩ ±1% resistor (0402)
R14, R43	2	5.1kΩ ±5% resistors (0402)
R15, R16, R19, R25, R27, R28, R29	0	Not installed, resistors
R17, R20, R21, R22, R24	5	10kΩ ±5% resistors (0402)
R23	1	49.9Ω ±1% resistor (0402)
R26	1	0Ω ±5% resistor (0402)
R30	1	6.2kΩ ±5% resistor (0402)
R31, R33	2	4.7kΩ ±5% resistors (0402)
R32	1	1kΩ ±5% resistor (0402)
R34	1	160kΩ ±5% resistor (0402)
R36, R38	2	39kΩ ±5% resistors (0402)
U1	1	MAX2170ETL+
U2	1	MAX4453ESA+ single-supply op amp with rail-to-rail outputs
U3	1	Hex buffer/driver Texas Instruments SN74LV07ADB
U4	1	MAX4729EXT+ low-voltage, SPDT CMOS analog switch
Y2	1	24.576MHz crystal TXC Corporation 7B24500140
BB+, BB-, HOLD_AGC, J5, J14, MUX, REF, VDET, VGC_BB, VGC_RF, VTUNE	11	PC mini (red) Keystone 5000
GND, J15, TP1, TP2	4	PC mini (black) Keystone 5001
—	1	MAX2170EVKIT+ PCB

Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
AVX Corp.	843-448-9411	843-448-7139	www.avxcorp.com
Central Semiconductor Corp.	631-435-1110	631-435-1824	www.centralsemi.com
Coilcraft, Inc.	847-639-6400	847-639-1469	www.coilcraft.com
Murata Mfg. Co., Ltd.	770-436-1300	770-436-3030	www.murata.com
Philips	800-447-1500	—	www.nxp.com
Texas Instruments Inc.	800-336-5236	—	www.ti.com
TXC Technology	714-990-5510	714-990-5520	www.txc.com.tw

Note: *Indicate that you are using the MAX2170 when contacting these component suppliers.*

Quick Start

Recommended Equipment

This section lists the recommended test equipment to verify operation of the MAX2170. It is intended as a guide only, and some substitutions are possible:

- One RF signal generator capable of delivering at least +5dBm of output power at the operating frequency (HPE4433B or equivalent)
- An RF spectrum analyzer that covers the MAX2170 operating-frequency range (e.g., FSEB20)
- A power supply capable of up to 1A at +2.7V to +6.0V
- One ammeter for measuring the supply current (optional)
- 50Ω SMA cables
- 50Ω BNC cables
- A network analyzer (e.g., HP 8753D) to measure small-signal return loss (optional)

Procedure

Measurement Considerations

The MAX2170 EV kit includes an on-board buffer that converts the baseband differential outputs to a single-ended output (see Figure 1 for details). The buffer is configured for a gain of one. The output of the buffer consists of a 50Ω resistor in series for matching to RF test equipment. Note that there is a 6dB loss at the output if 50Ω test equipment is used. This loss must be accounted for when measuring gain.

Connections and Setup

The MAX2170 EV kit is fully assembled and tested. This section provides a step-by-step guide to operating the EV kit and testing the device's function. **Caution:** Do not turn on the DC power or RF signal generators until all connections are made:

1) Connect a DC supply set to +3.0V (through an ammeter if desired) to the VCC and GND terminals on the EV kit. Do not turn on the supply. Note that VCC and VCC2 on the EV kit board are shorted together through JP3.
2) Connect a DC supply set to +2.4V (maximum gain) to the RFAGC terminal on the EV kit. Do not turn on the supply.
3) Connect a DC supply set to +2.4V (maximum gain) to the BBAGC terminal on the EV kit. Do not turn on the supply.
4) Connect one RF signal generator to either the VHF-III, FM, or L-BAND input through the SMA connectors J3 and J4, respectively. Do not turn on the generator's output.
5) Connect the baseband output on the EV kit to a spectrum analyzer through a BNC cable.
6) Connect the EV kit board to the PC through a parallel cable.
7) Turn on the DC supply. The supply current should read approximately 70mA.
8) Run the control software on an IBM-compatible PC. Using the control software, configure the following:
   a) Select the desired band of operation and channel through the **Block** section of the software's graphical interface.
   b) Based on the LO frequency, the EV kit software automatically sets the appropriate tracking-filter settings in VHF/FM mode.
   c) The power-detector threshold is factory-calibrated to a typical input power of -52dBm. This information is stored in bits <7:5> of register 00 in the ROM table. The EV kit software automatically loads the information stored in bits <7:5> of register 00 in the ROM table into bits <7:5> in register 08 to set the proper power-detector response.
   d) The baseband filter is factory-trimmed to have a typical bandwidth (-3dB corner) at 0.8 MHz. The information is stored in bits <2:0> of register 04 in the ROM table. The EV kit software automatically loads the information stored in bits <2:0> of register 04 in the ROM table into bits <2:0> in register 08 to set proper baseband filter bandwidth.
   e) The VCO Auto Selection (VAS) is already enabled through default settings (this allows the software to pick the appropriate VCO sub-band for the desired operation frequency). If desired, the VAS can be turned off to manually select the desired sub-band. VAS can be disabled through the VAS_EN bit on the **Registers** or **Block** section of the software.
9) Activate and set the power level of the RF generator to achieve $1V_{P-P}$ at the IF connector output or $0.5V_{P-P}$ (-2dBm) when loaded by a 50Ω instrument.

Note the 6dB loss at the output ports of the EV kit due to the 50Ω resistor in series at the buffer outputs and the 50Ω load of the test equipment.

Gain Control

The RF and baseband VGA circuits of the MAX2170 are controlled independently through jumpers JP10 and JP4, respectively. Connecting pins 2-3 of JP10 closes the RF gain control loop. The MAX2170 EV kit also implements a control loop for the baseband VGA through shorting pins 1-2 of JP4. The HOLD_AGC controls the MAX4729 analog switch (see Figure 1 for schematic details). In typical applications, the demodulator controls the baseband VGA. The analog switch and the external AGC circuitry (Q1, Q2, and Q3) are optional components and only needed when the demodulator lacks a baseband AGC control circuit.

Layout Issues

A good PCB is an essential part of an RF circuit design. The EV kit PCB serves as a guide for laying out a board using the MAX2170. Keep traces carrying RF signals as short as possible to minimize radiation and insertion loss. Use impedance control on all RF signal traces. The exposed paddle must be soldered evenly to the board's ground plane for proper operation. Use abundant vias beneath the exposed paddle and between RF traces to minimize undesired RF coupling.

To minimize coupling between different sections of the IC, each V_{CC} pin must have a bypass capacitor with low impedance to the closest ground at the frequency of interest. Do not share ground vias among multiple connections to the PCB ground plane. Refer to the *Layout* section of the MAX2170 data sheet for more information.

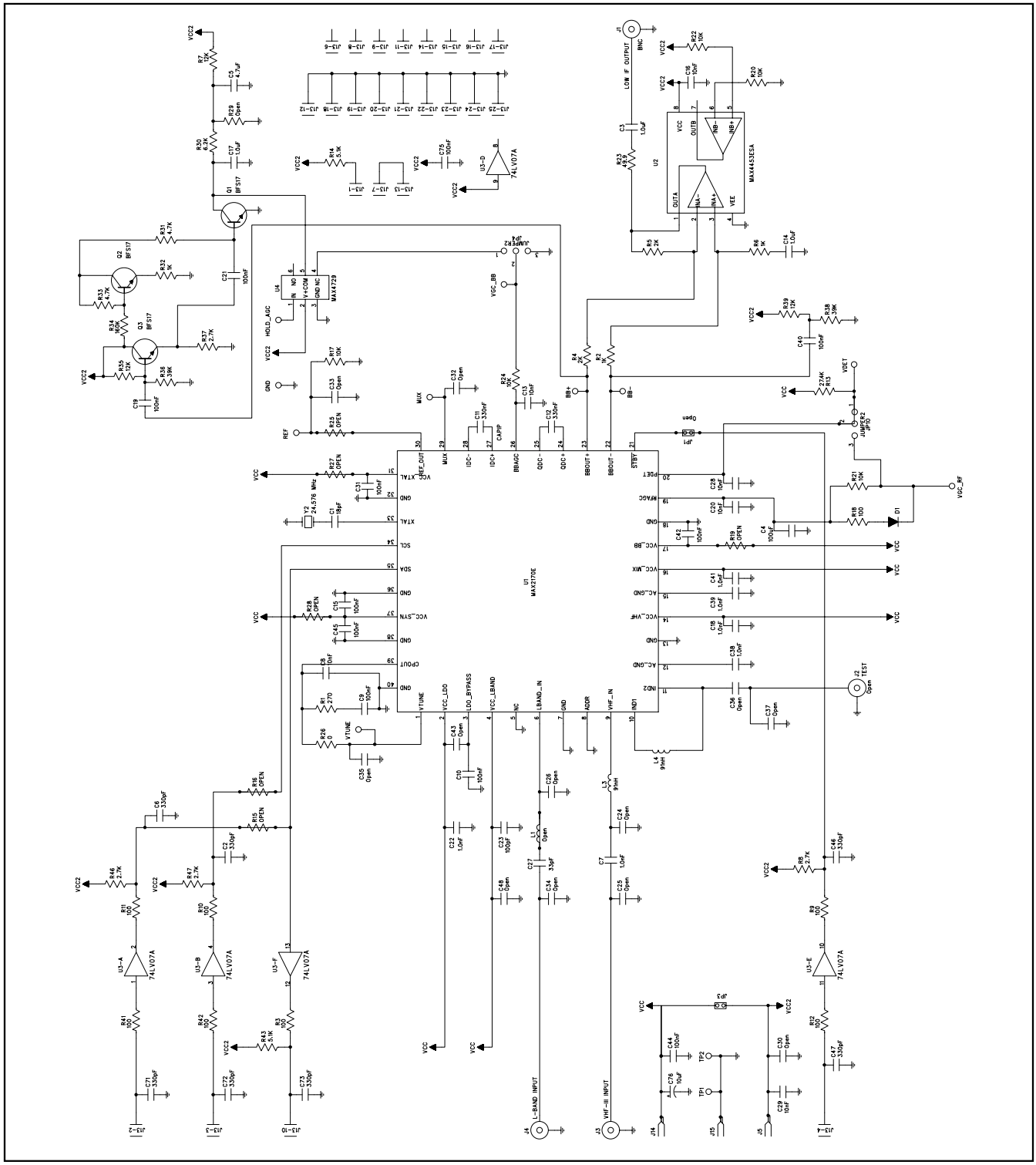

Figure 1. MAX2170 EV Kit Schematic

MAX2170 Evaluation Kit

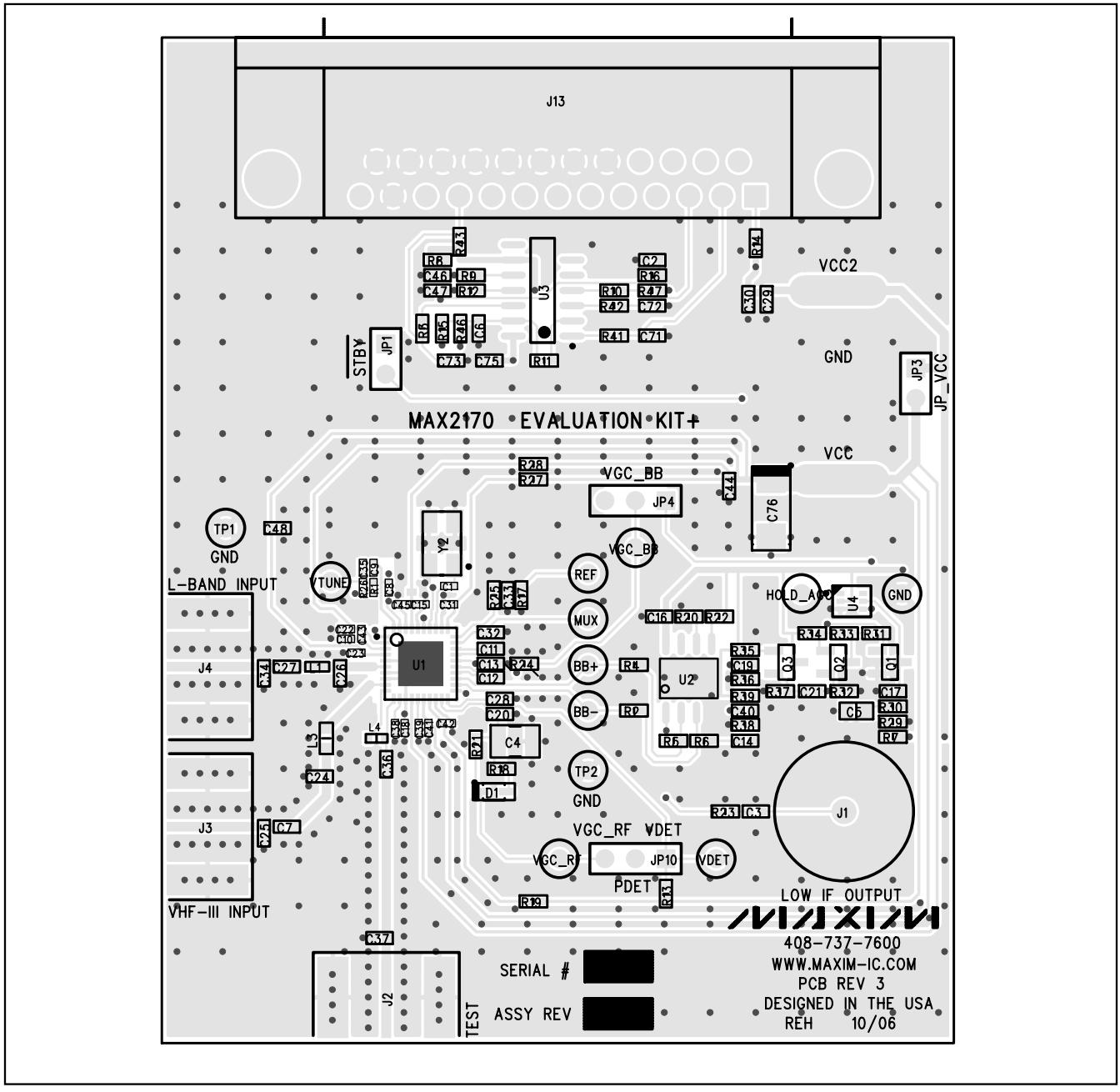

Figure 2. MAX2170 EV Kit Component Placement Guide—Component Side

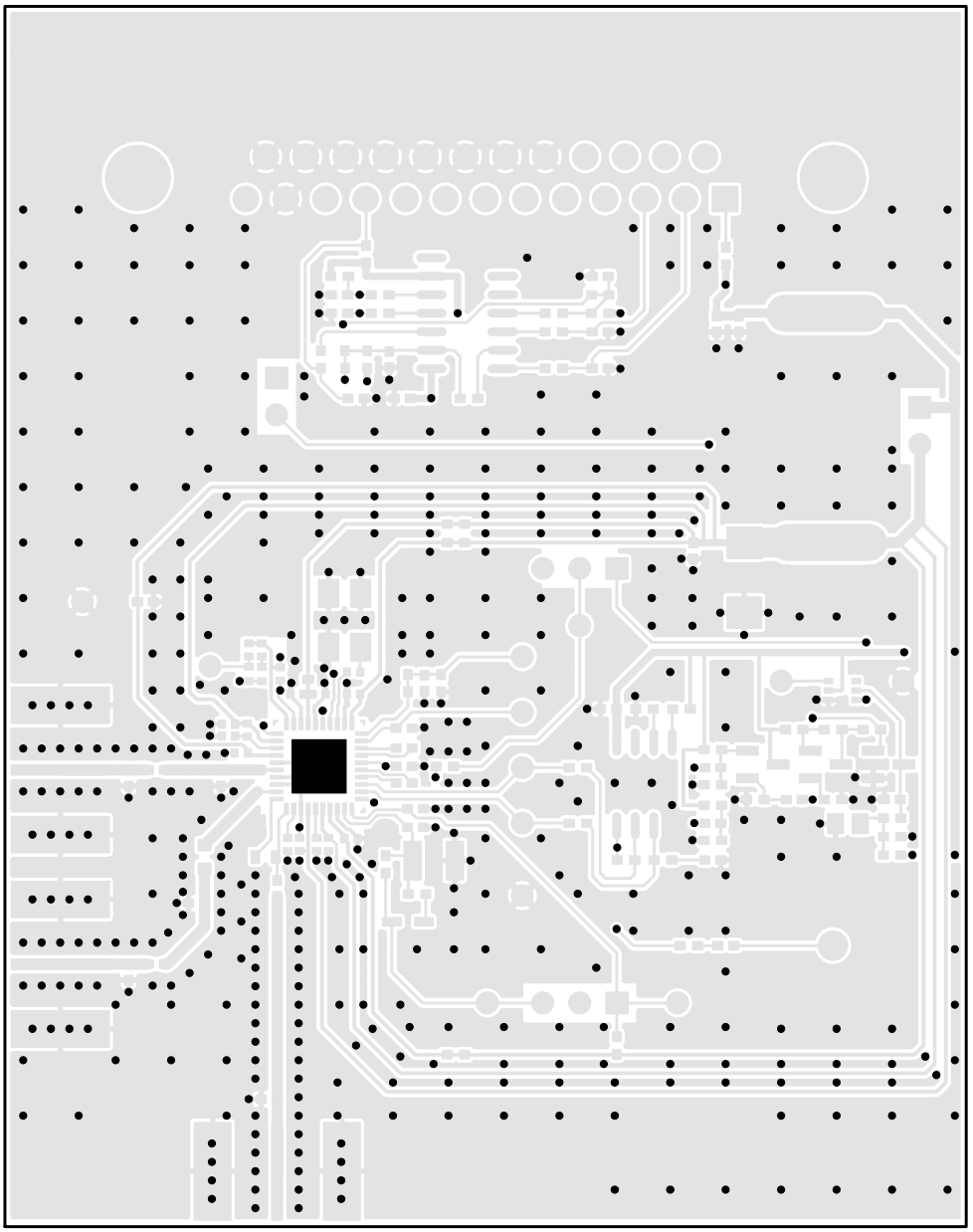

Figure 3. MAX2170 EV Kit PCB Layout—Component Side

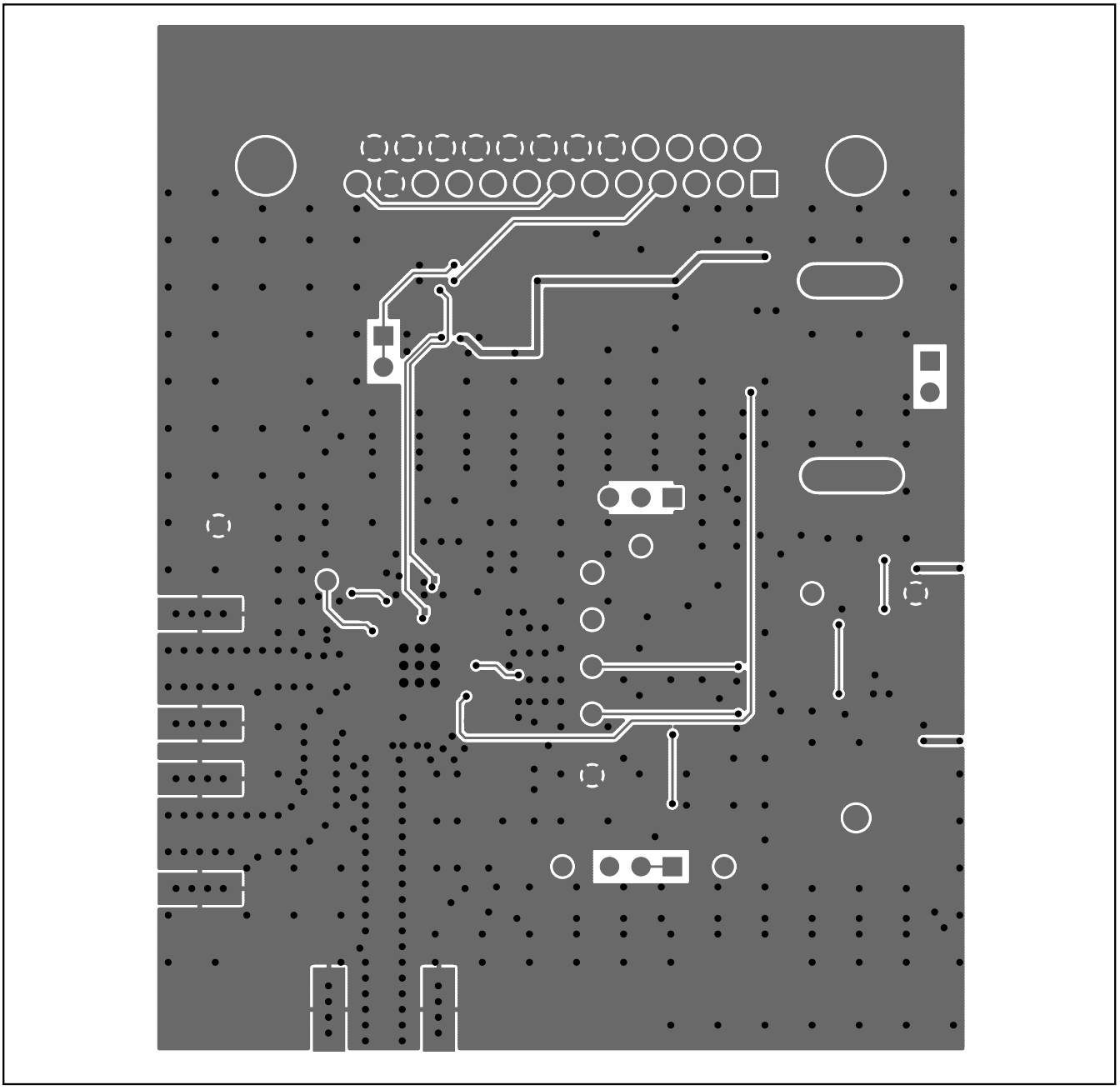

Figure 4. MAX2170 EV Kit PCB Layout—Solder Side

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