19-0108; Rev 2; 10/96

MAXIM

MAX121 Evaluation Kit

Evaluates: MAX121

General Description

The MAX121 evaluation kit (EV kit) is fully assembled, and provides a proven design and PC board layout for fast easy evaluation of the MAX121 at sample rates to 312k samples per second (ksps).

The kit includes a 5MHz oscillator, shift register, and LED display; the only external signal required is an analog input. Optional jumpers on the board may be configured so that the kit can be used with external circuits. The board operates in continuous-conversion mode, or in conjunction with external clock and control signals. Connectors provide easy interface between the MAX121 EV kit and the user's DSP or microprocessor system.

Features

- ♦ **±5V Input Range**
- ♦ **78dB SINAD**
- ♦ **Continuous-Conversion Mode with 312.5ksps Operation Rate**
- ♦ **26-Pin Ribbon Cable Connector for Connection to a User's DSP System**
- ♦ **On-Board LED Display**
- ♦ **3in^2 Prototyping Area**

Ordering Information

PART	TEMP. RANGE	BOARD TYPE
MAX121EVKIT-DIP	0°C to +70°C	Through-Hole

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	0.01µF 50V ceramic capacitor (optional)
C2, C4, C8	3	10µF 16V radial electrolytic capacitors
C3, C5, C6, C9, C10, C11	6	0.1µF 50V ceramic capacitors
C7	1	22µF 50V low-ESR radial electrolytic capacitor*
D1-D14	14	Red LEDs
IC1	1	MAX121CPE
IC2, IC3	2	74HC595 shift registers
IC4	1	5.0MHz crystal oscillator
R1	1	0Ω 5% resistor
R2-R15	14	620Ω 5% resistors
J1-J3	3	BNC connectors
JU1-JU6	6	3-pin jumper headers
JU7	1	2-pin jumper header
None	7	Shunts
None	1	3-pin power connector
None	1	26-pin ribbon cable connector
None	1	5.00" x 5.00" PC board
None	4	Rubber feet
None	1	MAX121 data sheet
None	1	MAX121 EV kit manual

*The reference bypass capacitor's ESR should be less than 0.1Ω and as low as possible. For production quantities of this capacitor, see list of possible suppliers below:

MANUFACTURER	PRODUCT LINE
Nichicon Corporation, (708) 843-7500	PL series
Sanyo Electric Company, (619) 661-6835	SA or SC series
United Chemi-Con, (708) 696-2000	LXF series
Matsuo Electronics, (714) 969-2491	267 series (surface-mount)
Sprague Electric Company, (603) 224-1961	595D series (surface-mount)

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Quick Reference

The evaluation kit is shipped configured for the continuous-conversion mode. To verify operation, follow these steps:

1. Verify that the jumpers are configured as described in Table 2.
2. Connect the power supplies (+5V and -12V to -15V) to the power input connector.
3. Connect an analog input to the AIN input.
4. Read the conversion results on the LEDs.

General Description

Seven jumpers on the evaluation board configure the kit for various modes of operation. Table 1 lists the jumpers and their functions. Table 2 outlines the jumper configuration for the continuous-conversion mode. This mode can be used for board verification as well as MAX121 evaluation. Refer to the MAX121 data sheet for full descriptions of the device operating modes.

Table 1. Jumper Functions

JUMPER	CONNECTION	FUNCTION
JU1	1 & 2	SCLK output noninverted
	2 & 3	SCLK output inverted
JU2	1 & 2	SFRM output noninverted
	2 & 3	SFRM output inverted
JU3*	Open	MODE pin open (single conversion, $\overline{BUSY}$ output)
	1 & 2	MODE pin connected to V_{DD} (Single conversion, $\overline{INT}$ output)
	2 & 3	MODE pin connected to GND (continuous conversions, $\overline{BUSY}$ output)
JU4	1 & 2	External clock source connected to CKLIN
	2 & 3	On-board crystal oscillator connected to CLKIN
JU5	1 & 2	External $\overline{CS}$ signal
	2 & 3	$\overline{CS}$ connected to GND
JU6	1 & 2	External $\overline{CONVST}$ signal
	2 & 3	$\overline{CONVST}$ connected to GND
JU7	Open	LED display disabled
	Shorted	LED display enabled

***NOTE:** The MODE pin must be set before power is applied to the device. To change the mode, turn power off, move the shunt, and restore power.

Table 2. Jumper Configuration for Continuous-Conversion Mode

JUMPER	CONNNECTION	FUNCTION
JU1	2 & 3	SCLK output inverted
JU3	2 & 3	MODE pin connected to GND
JU4	2 & 3	Use on-board crystal oscillator
JU5	2 & 3	$\overline{CS}$ connected to GND
JU6	2 & 3	$\overline{CONVST}$ connected to GND
JU7	Shorted	LED display enabled

NOTE: The SFRM signal is not used, so the position of JU2 has no effect.

Clock Circuit

The EV kit includes a 5.0MHz oscillator that allows the fastest possible conversion rate in the continuous-conversion mode. See *Timing Diagrams* section for detailed timing.

The MAX121 operates with an input clock (CLKIN) of 0.1MHz to 5.5MHz. Conversion accuracy will deteriorate outside of this range due to track/hold charge leakage at lower frequencies and inadequate settling times at higher frequencies.

To use an external clock, configure JU4 for external clock source (shunt across 1 & 2) and connect the clock source to J1 (EXT CLOCK). A clock rate up to 5.5MHz may be used when the conversion rate allows greater than 400ns acquisition time.

Shift-Register Circuit

The evaluation kit uses a pair of 74HC595 shift registers to convert the MAX121's serial output to a parallel format for display on the LEDs. The latched data is also available on the 26-pin data connector.

The 74HC595 serial clock (SCLK) is driven by the MAX121's SCLK output. The MAX121's invert-clock pin ($\overline{INVCLK}$) must be grounded so that the SCLK output has the proper timing relationship to the data output pin (SDATA). The 74HC595 latching signal (RCLK) is driven by the MAX121's frame-start output (FSTRT). A

frame-start pulse occurs every 16 clock cycles in the continuous-conversion mode. Figure 1's timing diagram illustrates the start of a conversion cycle.

The 74HC595 shift register is offset one bit because of the relationship of the frame-start pulse to the data stream. Figure 1 shows the single SCLK cycle that occurs between the shift-register latch (FSTRT positive edge) and the MSB value appearing on SDATA. The 14 bits of data from the MAX121 are then loaded serially into shift register on the following clock cycles. The timing diagram in Figure 2 illustrates a full conversion cycle.

The 74HC595 shift-register circuit may not function properly when external chip-select ($\overline{CS}$) or conversion-start ($\overline{CONVST}$) signals are used. The LED display should be disabled and the MAX121 serial output monitored by other means.

The LED display on the output of the shift registers is for convenience only. It may induce some noise when the input code is near a major carry. The worst code would be 0 to -1 (00000000000000B 11111111111111B). The LED display should be disabled for critical noise or accuracy measurements. The output code can be monitored by the user's DSP system, or by observing the MAX121's SDATA pin with a scope.

Timing Diagrams

Figure 1 is the timing diagram for the MAX121 EV kit in the continuous-conversion mode. The kit is shipped with a 5.0MHz crystal oscillator so the 16 clock-cycle conversion is 3.2µs (312.5ksps). This is the fastest usable rate in the continuous-conversion mode because the acquisition time (2 clock periods) must be a minimum of 400ns. Although the data sheet indicates a maximum rate of 308ksps, the 312.5ksps rate is valid in continuous-conversion mode at room temperature. The data-sheet specification reflects the conditions used for production testing. The MAX121 is guaranteed over temperature at 308ksps.

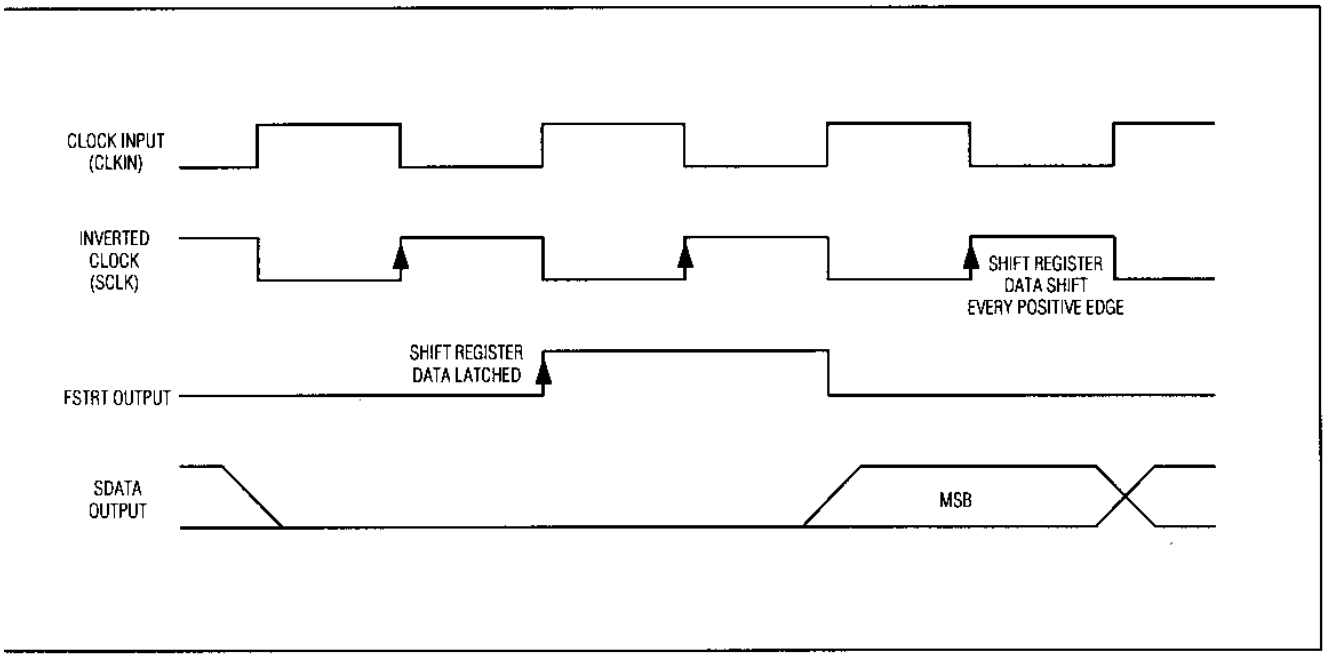

Figure 1. MAX121 Conversion Start

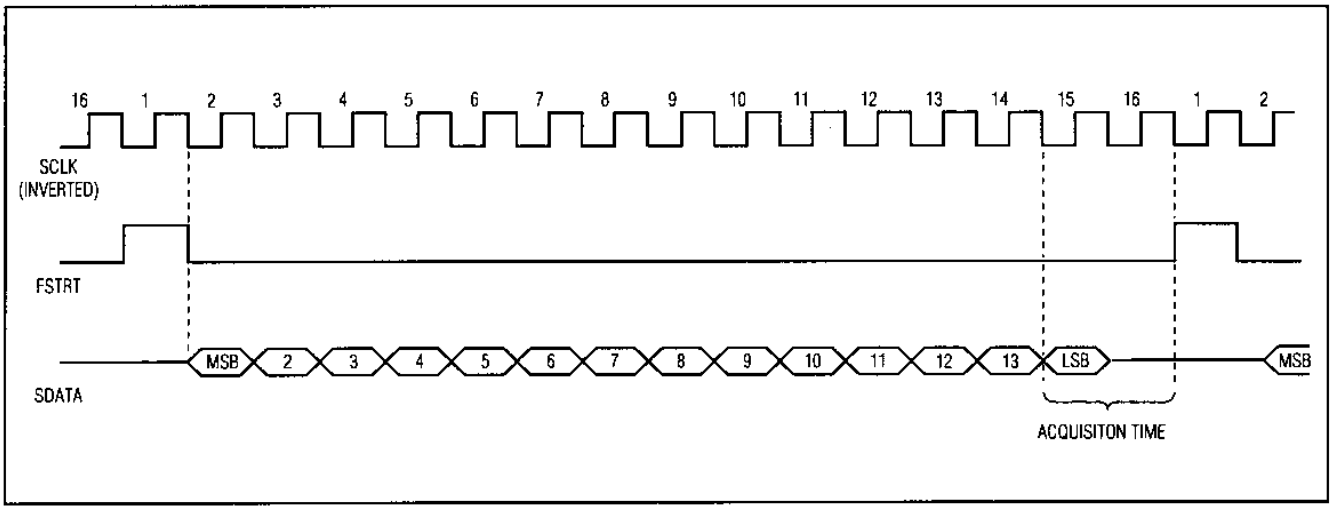

Figure 2. MAX121 EV Kit Continuous-Conversion Mode Timing

Applications Information

The equivalent circuit for the MAX121 input is a 6kΩ resistor connected to -5V. This requires a low-impedance source to drive the MAX121. A high-frequency op amp such as the OP-27 is a good choice for this application. Optional capacitor C1 helps to provide a low AC source impedance at the MAX121 input.

A board location for a single-pole filter is provided at the input of the MAX121; however, the presence of R1 will induce a gain error because of the MAX121's 6kΩ input resistance. For example, a 51Ω resistor will induce approximately 1% (51/6000) gain error. For any given filter, R1 should be as low as possible, and the capacitor C1 should be selected for the proper frequency.

The reference-voltage pin (VREF) must be bypassed to analog ground (AGND) with a 0.1µF ceramic capacitor and 22µF low-ESR electrolytic capacitor. The large-value electrolytic capacitor should have the lowest possible equivalent series resistance (ESR). It is also important to keep the capacitor's leads (or traces) as short as possible.

When observing the LED display as the input is slowly varied, the LSB changes in brightness, but is never 100% on or off. When the device is used in DSP applications, where large numbers of samples are taken, the noise is effectively reduced through averaging.

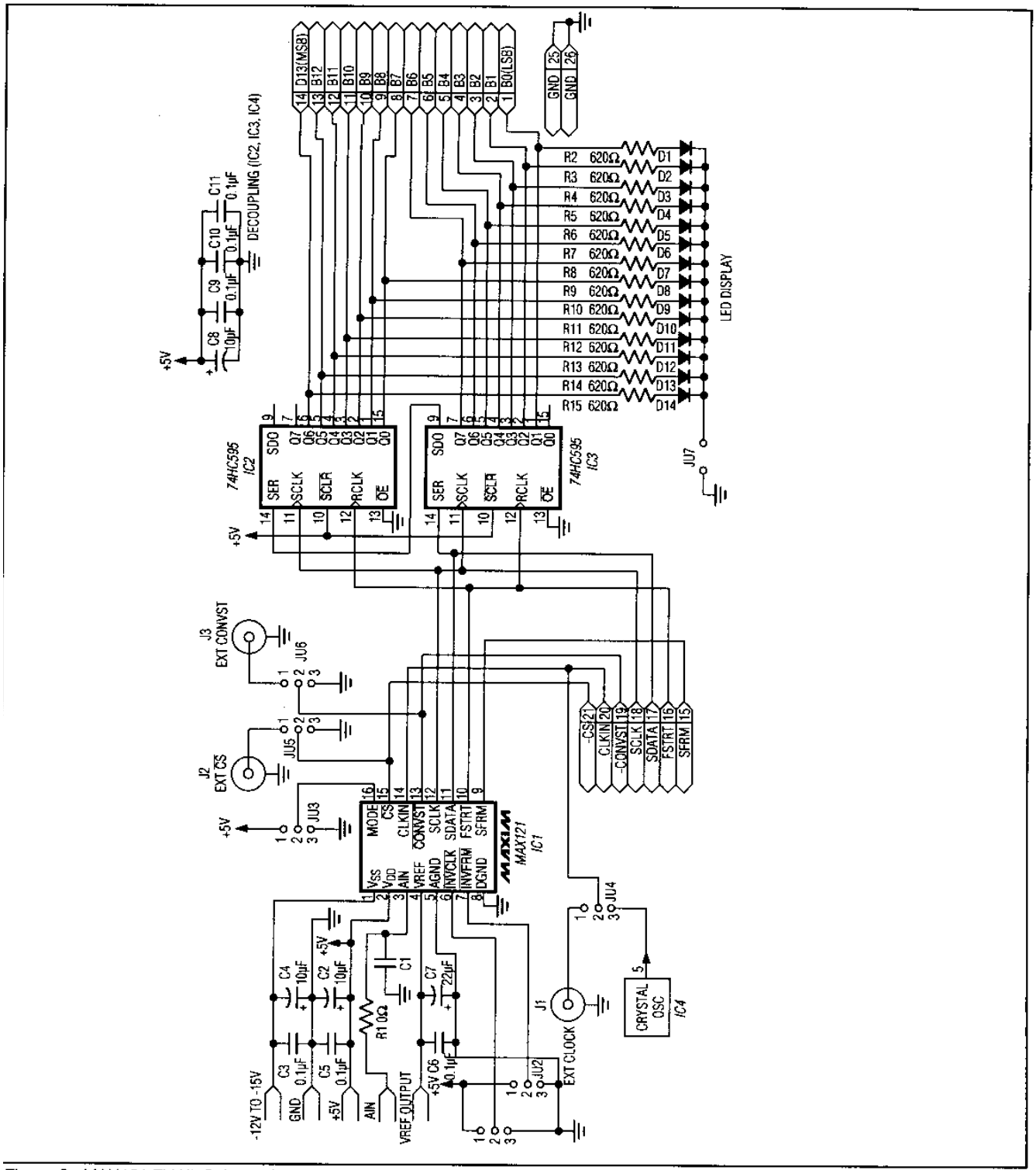

Figure 3. MAX121 EV Kit Schematic

MAX121 Evaluation Kit

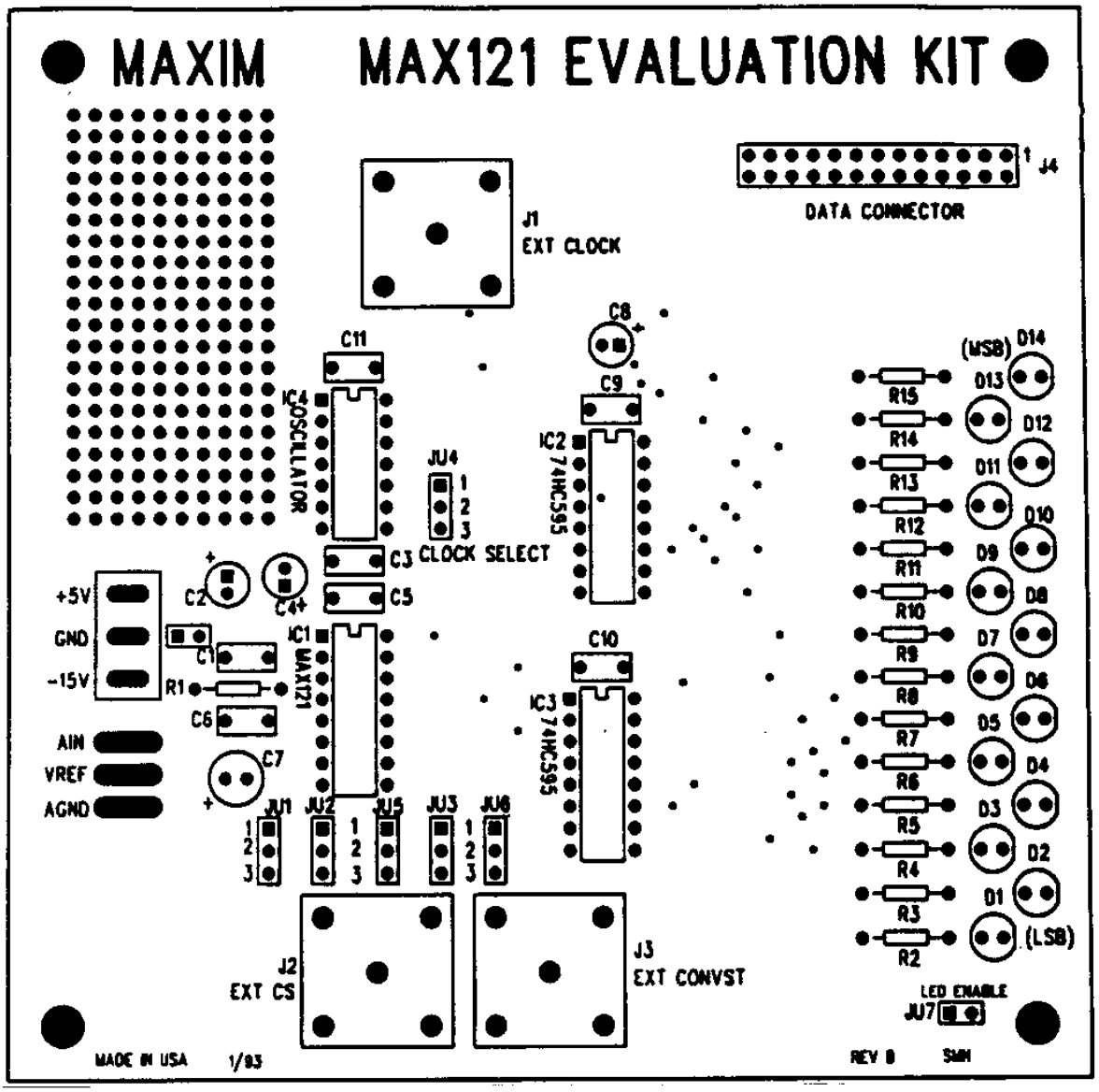

Figure 4. MAX121 EV Kit Component Placement Guide

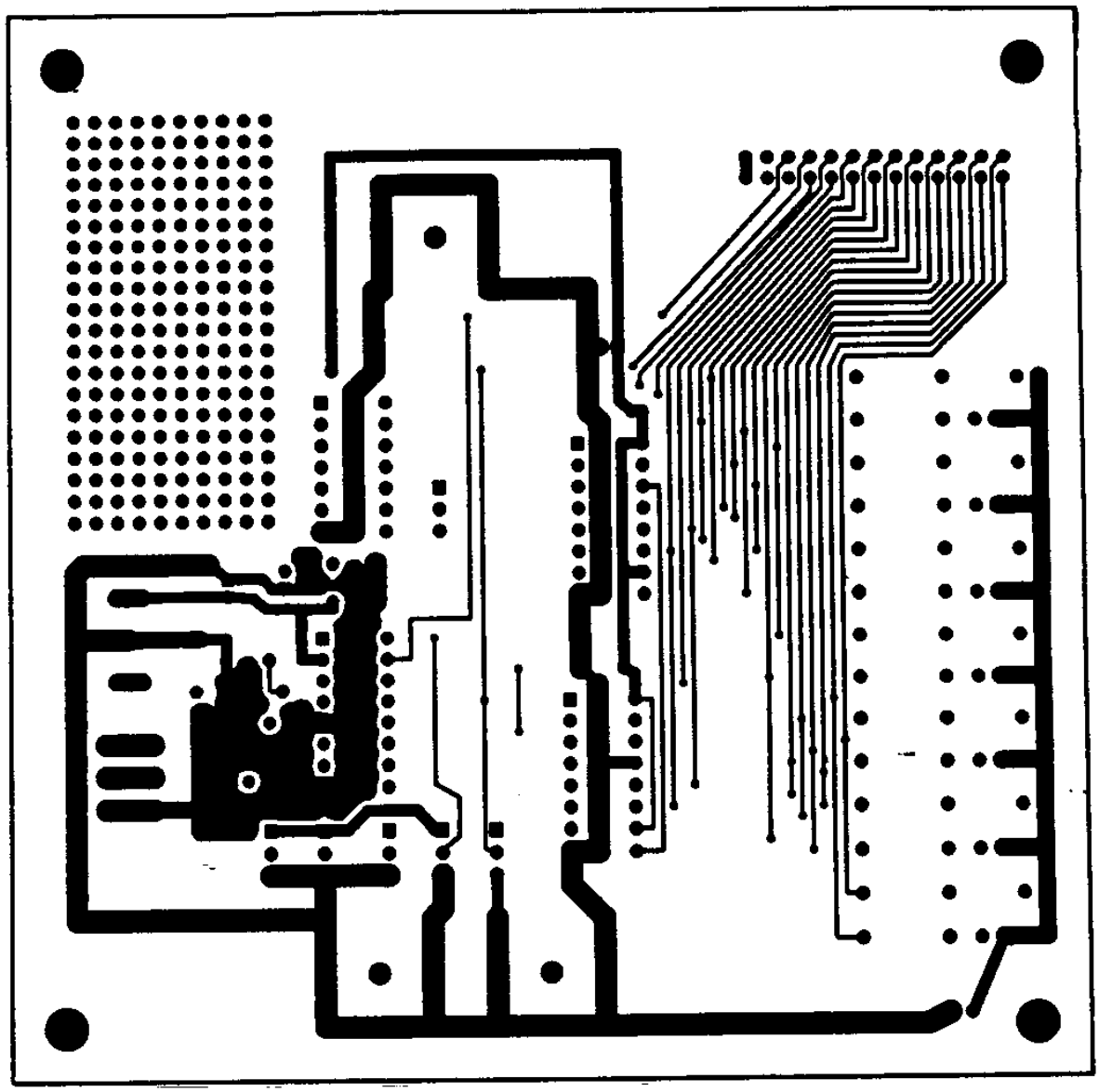

Figure 5. MAX121 EV Kit Component-Side Layout

MAX121 Evaluation Kit

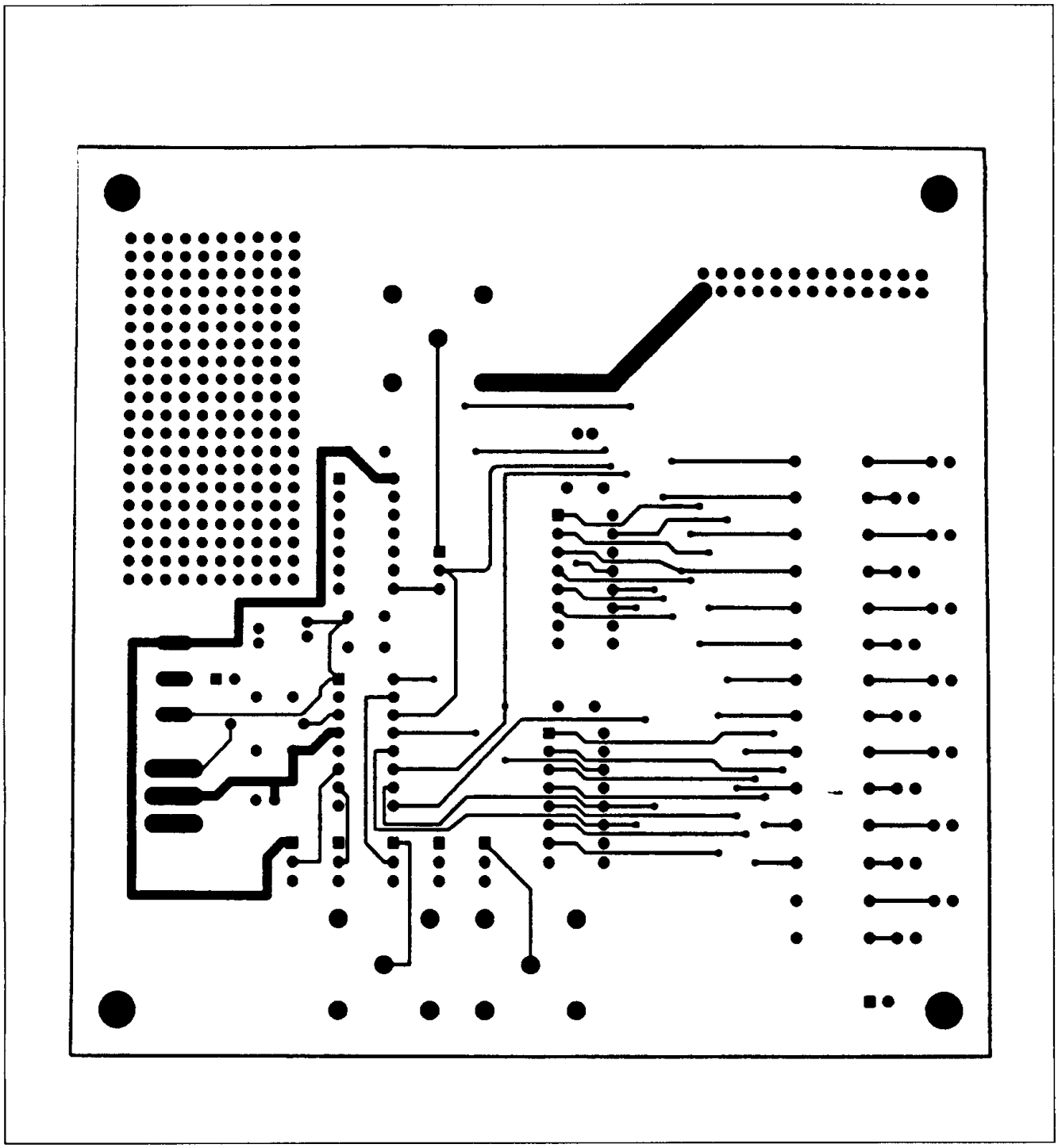

Figure 6. MAX121 EV Kit Solder-Side Layout