



MAX1308 Evaluation Kit/Evaluation System

General Description

The MAX1308 evaluation system (EV system) is a complete 8-channel, 12-bit, data-acquisition system. The MAX1308 EV system (MAX1308EVB16) consists of a MAX1308 evaluation kit (EV kit), Maxim 68HC16MOD-16WIDE microcontroller (μ C) module, and USBTO232. Order the EV kit (MAX1308EVKIT) separately if the user has a parallel bus controller or if the 68HC16MOD-16WIDE μ C module has already been purchased.

The MAX1308 EV kit can be used to evaluate the MAX1308 with an external system clock. In this mode, the 68HC16MOD-16WIDE board cannot be used and the user must supply a parallel interface.

The EV kit comes with the MAX1308ECM installed. To evaluate the pin-compatible MAX1304ECM-MAX1307ECM and MAX1309ECM-MAX1315ECM, contact the factory for free samples.

MAX1308EVB16 Component List

PART	QTY	DESCRIPTION
MAX1308EVKIT	1	MAX1308 EV kit
68HC16MOD-16WIDE	1	68HC16 μ C module
USBTO232+	1	USB-to-COM port adapter board

+Denotes lead-free and RoHS compliance.

DESIGNATION	QTY	DESCRIPTION
C1-C6, C39	7	2.2 μ F \pm 10%, 25V X7R ceramic capacitors (1206) TDK C3216X7R1E225K
C7-C27	21	0.1 μ F \pm 10%, 25V X7R ceramic capacitors (0603) TDK C1608X7R1E104K
C28, C29	2	0.01 μ F \pm 10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E103K
C30	1	4.7 μ F \pm 10%, 16V X7R ceramic capacitor (1206) TDK C3216X7R1C475K
C31-C38	8	470pF \pm 10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H471K
ECLK, CONVST	2	SMA connectors
FB1	1	Ferrite bead TDK MMZ1608B601C (0603)
J1	1	2 x 9-pin header
J2	1	2 x 12-pin header

Windows is a registered trademark of Microsoft Corp.

Features

- ◆ Proven PCB Layout
- ◆ Buffers on All Input Channels
- ◆ Headers to Connect EV System to Logic Analyzer
- ◆ Fully Assembled and Tested
- ◆ EV Kit Software Supports Windows® 98/2000/XP with RS-232/COM Port
- ◆ EV Kit Software Supports Windows 2000/XP with USB Port

Ordering Information

PART	INTERFACE TYPE
MAX1308EVKIT	User-supplied parallel-bus controller
MAX1308EVB16	Windows software

Note: The MAX1308 software is included with the MAX1308 EV kit but is designed for use with the complete EV system. The EV system includes the Maxim μ C module, USBTO232, and the EV kit. If the Windows software will not be used, the EV kit board can be purchased without the Maxim μ C module.

Note: To evaluate the MAX1304ECM-MAX1307ECM or the MAX1309ECM-MAX1315ECM, request a free sample when ordering the MAX1308EVKIT or MAX1308EVB16.

MAX1308EVKIT Component List

DESIGNATION	QTY	DESCRIPTION
J3, J4	2	2 x 20, 0.1in right-angle receptacles
JU1-JU12	12	2-pin headers
JU13-JU16	4	3-pin headers
JU17, JU18, JU19	0	Not installed (2-pin headers)
R1-R8	8	100k Ω \pm 5% resistors (0603)
R9-R16	8	10 Ω \pm 5% resistors (0603)
R17-R24	8	8.66k Ω \pm 1% resistors (0603)
R25-R32	8	24 Ω \pm 5% resistors (0603)
U1	1	8-channel, 12-bit ADC MAX1308ECM (48-pin TQFP)
U2-U5	4	Dual-supply op amps MAX4351ESA (8-pin SO)
U6	1	Ultra-high-precision voltage regulator MAX6126AASA25 (8-pin SO)
—	16	Shunts
—	1	PCB: MAX1308EVKIT
—	1	MAX1308 EV kit software, CD-ROM

Evaluate: MAX1304-MAX1315

MAX1308 Evaluation Kit/Evaluation System

MAX1308 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX1308.EXE	Application program
MAX1308.C16	68HC16MOD-16WIDE software
HELPPFILE.HTM	MAX1308 EV kit help file
UNINST.INI	Uninstalls the EV kit software
MAX1308.ASM	68HC16MOD-16WIDE μ C source file
EVKIT2.ASM	68HC16MOD-16WIDE μ C source file
GPT.ASM	68HC16MOD-16WIDE μ C source file
QSPI.ASM	68HC16MOD-16WIDE μ C source file

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Murata	770-436-1300	www.murata.com
TDK	847-803-6100	www.component.tdk.com

Note: Indicate you are using the MAX1308 when contacting these component suppliers.

Quick Start

Recommended Equipment—USB Port PC Connection Option

- MAX1308EVB16 EV system (MAX1308 EV kit, 68HC16MOD-16WIDE μ C module, and USBTO232)
- Three power supplies:
 - 1) 7V or higher (up to 20V) at 300mA for the 68HC16MOD-16WIDE
 - 2) 5V at 250mA for AVDD
 - 3) ± 5.5 V at 250mA for HVAVCC and HVAVEE (or ± 10 V at 250mA to evaluate the MAX1312ECM-MAX1315ECM)
- Waveform generator (optional)
- Digital voltmeter (DVM)
- User-supplied 9-pin serial extension cable
- User-supplied Windows 2000/XP PC with an available USB port
- USB cable included with the USBTO232
- Logic analyzer (optional)

Procedure

Caution: Do not turn on the power until all connections are completed.

- 1) Visit the Maxim website (www.maxim-ic.com/evkit-software) to download the latest version of the USBTO232 user guide. Follow the steps in the USBTO232 user guide *Quick Start* section and return to step 2 of this *Quick Start* section when finished.
- 2) Set JU1 to 1-2 (selects midscale reference for bipolar operation).
- 3) Set JU2 to 1-2 (selects on-board external reference).
- 4) Remove the shunt from JU3 (disables auto-read feature).
- 5) Set JU4 to 1-2 (enables the MAX1308 internal clock).
- 6) Set JU5–JU12 to 1-2 (selects buffered input for channel 0 through channel 7).
- 7) Set JU13 to 2-3 (selects midscale reference for bipolar operation).
- 8) Set JU14 to 1-2 (enables the MAX1308 internal clock).
- 9) Set JU15 to 2-3 (selects VCC from 68HC16MOD-16WIDE as DVDD).
- 10) Set JU16 to 2-3 (selects HVAVCC pad as positive supply for input buffers).
- 11) Connect the MAX1308 EV kit's two 40-pin female connectors (J3 and J4) to the 68HC16MOD-16WIDE module's two 40-pin male connectors (P1 and P2).
- 12) Connect the USBTO232 board to the 68HC16MOD-16WIDE-DIP module if you have not done so already.
- 13) The MAX5734 EV kit software should have already been downloaded and installed in the USBTO232 *Quick Start*.
- 14) Connect the +5V power supply between the MAX1308 EV kit's AVDD and AGND pads.
- 15) Connect the ± 5.5 V power supply to the MAX1308 EV kit (+5.5V to HVAVCC pad, ground to AGND pad, and -5.5V to HVAVEE pad).
- 16) Connect the 7V (up to 20V supported) power supply to the 68HC16MOD-16WIDE's power connector (J2).
- 17) Turn on all three power supplies.
- 18) Turn on the 68HC16MOD-16WIDE by setting SW1 to the ON position.
- 19) Measure the voltage at REF using the DVM and verify that the voltage is $2.500\text{V} \pm 0.025\text{V}$.
- 20) Start the MAX1308 EV kit software by double-clicking its icon in the **Start | Programs** menu.

MAX1308 Evaluation Kit/Evaluation System

Recommended Equipment—RS-232/COM Port PC Connection Option

- MAX1308EVB16 EV system (MAX1308 EV kit and 68HC16MOD-16WIDE μ C module)
- Three power supplies:
 - 1) 7V or higher (up to 20V) at 300mA for the 68HC16MOD-16WIDE
 - 2) 5V at 250mA for AVDD
 - 3) ± 5.5 V at 250mA for HVAVCC and HVAVEE (or ± 10 V at 250mA to evaluate the MAX1312ECM–MAX1315ECM)
- Waveform generator (optional)
- Digital voltmeter (DVM)
- User-supplied 9-pin serial extension cable
- User-supplied Windows 98/2000/XP PC with an available RS-232 serial port
- Logic analyzer (optional)

Procedure

Caution: Do not turn on the power until all the connections are completed.

- 1) Visit the Maxim website (www.maxim-ic.com/evkit-software) to download the latest version of the EV kit software. Save the EV kit software to a temporary folder and uncompress the file (if it is a .zip file).
- 2) Install the MAX1308 EV kit software on your computer by running the INSTALL.EXE program. The program files are copied and icons are created for them in the Windows **Start | Programs** menu.
- 3) Set JU1 to 1-2 (selects midscale reference for bipolar operation).
- 4) Set JU2 to 1-2 (selects on-board external reference).
- 5) Remove the shunt from JU3 (disables autoread feature).
- 6) Set JU4 to 1-2 (enables the MAX1308 internal clock).
- 7) Set JU5–JU12 to 1-2 (selects buffered input for channel 0 through channel 7).
- 8) Set JU13 to 2-3 (selects midscale reference for bipolar operation).
- 9) Set JU14 to 1-2 (enables the MAX1308 internal clock).
- 10) Set JU15 to 2-3 (selects VCC from 68HC16MOD-16WIDE as DVDD).
- 11) Set JU16 to 2-3 (selects HVAVCC pad as positive supply for input buffers).
- 12) Connect the MAX1308 EV kit's two 40-pin female connectors (J3 and J4) to the 68HC16MOD-16WIDE module's two 40-pin male connectors (P1 and P2).
- 13) Connect the 9-pin serial cable from the computer's serial port to the 68HC16MOD-16WIDE module's DB9 connector (J3). Use a USB-to-serial adapter if your computer does not have a serial port.
- 14) Connect the +5V power supply between the MAX1308 EV kit's AVDD and AGND pads.
- 15) Connect the ± 5.5 V power supply to the MAX1308 EV kit (+5.5V to HVAVCC pad, ground to AGND pad, and -5.5V to HVAVEE pad).
- 16) Connect the 7V (up to 20V supported) power supply to the 68HC16MOD-16WIDE's power connector (J2).
- 17) Turn on all three power supplies.
- 18) Turn on the 68HC16MOD-16WIDE by setting SW1 to the ON position.
- 19) Measure the voltage at REF using the DVM and verify that the voltage is $2.500\text{V} \pm 0.025\text{V}$.
- 20) Start the MAX1308 EV kit software by double-clicking its icon in the **Start | Programs** menu.

MAX1308 Evaluation Kit/Evaluation System

Detailed Description of Software

To start the software, double-click the MAX1308 EV kit icon that is created during installation. The Serial Form, shown in Figure 1, appears and the user must click **Ok** to upload the firmware to the 68HC16MOD-16WIDE and begin the program.

When the firmware has been uploaded and the μC on the 68HC16MOD-16WIDE has booted, the MAX1308 evaluation software (shown in Figure 2) appears.

The **Part** pulldown menu allows the user to select any part in the MAX1304ECM-MAX1315ECM family. By default, the MAX1308ECM is selected. The **Sampling** pulldown menu allows the user to select between three sampling modes: single sample, continuous sample, and block sample. Note that in block-sample mode, the user can select the sampling rate (per channel) and this rate changes depending on how many channels are selected.

The check boxes in the **Power Saving Modes** box allow the user to enable the different power-saving features of the MAX1308. The two check boxes are labeled SHDN pin and /CHSHDN pin and represent the state of the MAX1308's pin with the same designation. Checking and unchecking these boxes sets the corresponding IC pin high and low, respectively.

The **Channel Select** box contains a check box for each input channel of the IC. Checking the box allows the software to sample the channel.

The **Input Values** box displays the raw data and corresponding input voltage of all selected channels after sampling.

The **References** box allows the user to specify the exact references being used. The values for the reference voltage and the midscale voltage should be entered here. These values are used in the transfer function for converting the raw data into a corresponding input voltage.

The **Sample Options** box is used to control sampling in any of the three sampling modes. In single-sample mode, the **Sample** button is used to sample all selected channels once. In continuous-sample mode, the **Start** and **Stop** buttons are used to sample all selected channels and a sampling interval (between 200ms and 10,000ms) can be entered in the **Sampling Interval** text field. In block-sample mode, the **Sample** button is used to bring up the Sampling Tool (see Figure 3) and the **Sampling Frequency** scrollbar is used to select a sampling frequency per channel. Note that the sampling frequency is

adjusted as channels are selected/unselected and is typically accurate to within 0.5ms. To determine the exact sampling frequency per channel in block-sample mode, observe consecutive falling edges on the CONVST pin (J1-7) when sampling. To capture data for precision FFTs, use the MAX1308 EV kit with an external clock and a logic analyzer (instead of the 68HC16MOD-16 WIDE) to read the parallel bus. This improves the accuracy of the ADC clocking system.

When using the MAX1308 evaluation software, it can be useful to display the Serial Form and/or Graph Form. To display these forms, click on the appropriate command in the **Options** menu. The Serial Form displays all communication between the MAX1308 evaluation software and the 68HC16MOD-16WIDE. The Graph Form (see Figure 4) displays a graph of sampled results when the software is in continuous-sample mode.

Note that when viewing graphical information (using either the Graph Form in continuous-sample mode or done automatically in block-sample mode), the raw codes collected from the MAX1308 are converted from two's complement (or offset binary in unipolar devices) to signed decimal. The raw data can be saved to a text file using the **Save...** menu item in the graph window.

Detailed Description of Hardware

MAX1308EVB16 EV System

The MAX1308EVB16 is a complete 8-channel, 12-bit, data-acquisition system consisting of a MAX1308 EV kit and the Maxim 68HC16MOD-16WIDE μC module.

68HC16MOD-16WIDE μC Module

The 68HC16MOD-16WIDE provides a 16-bit parallel bus to demonstrate various Maxim devices. Maxim reserves the right to change the implementation of this module at any time with no advance notice.

MAX1308 EV Kit

The MAX1308 EV kit board provides a proven layout for evaluating the MAX1308 8-channel, 12-bit ADC and can be obtained separately without the 68HC16MOD-16WIDE μC module. The MAX1308 EV kit includes an on-board 2.5V reference (MAX6126) and buffers (MAX4351) for all eight input channels. The MAX1308ECM (U1) is powered from two sources. The user must supply +5V between AVDD and AGND, and +3V to +5V between DVDD and DGND. DVDD can also be supplied from the 68HC16MOD-16WIDE using JU15.

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

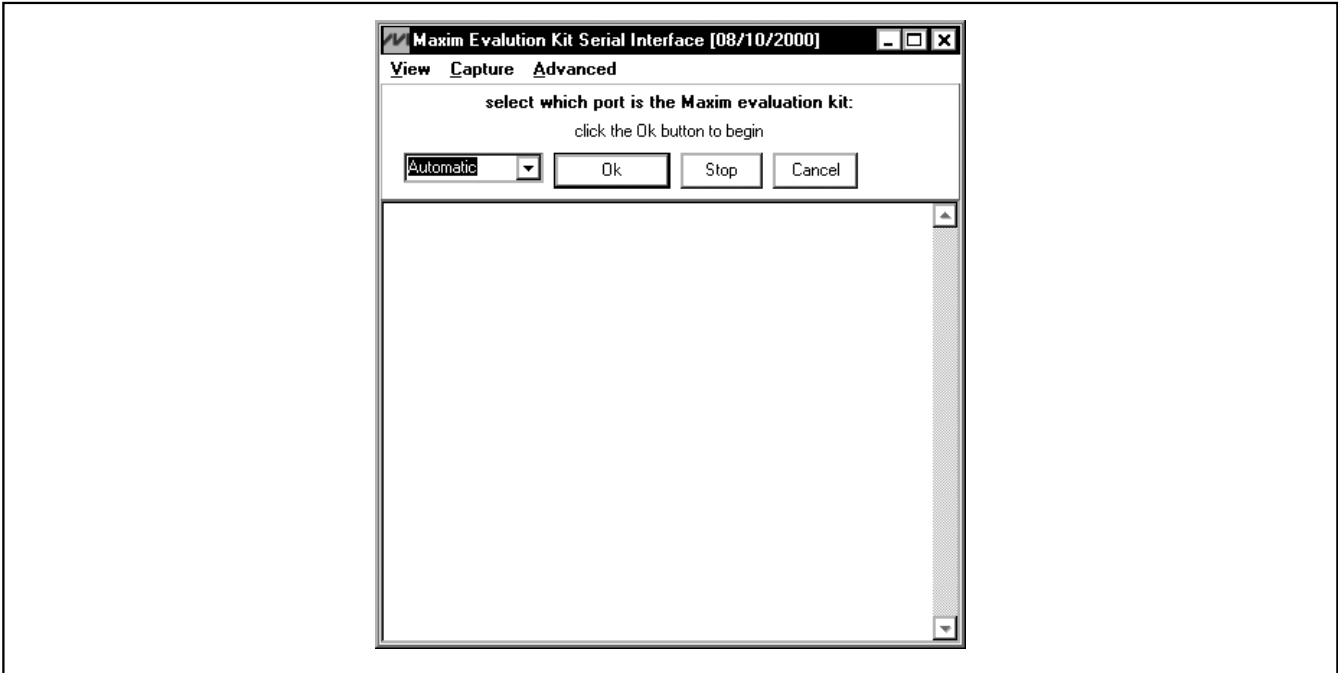


Figure 1. MAX1308 EV Kit Serial Form

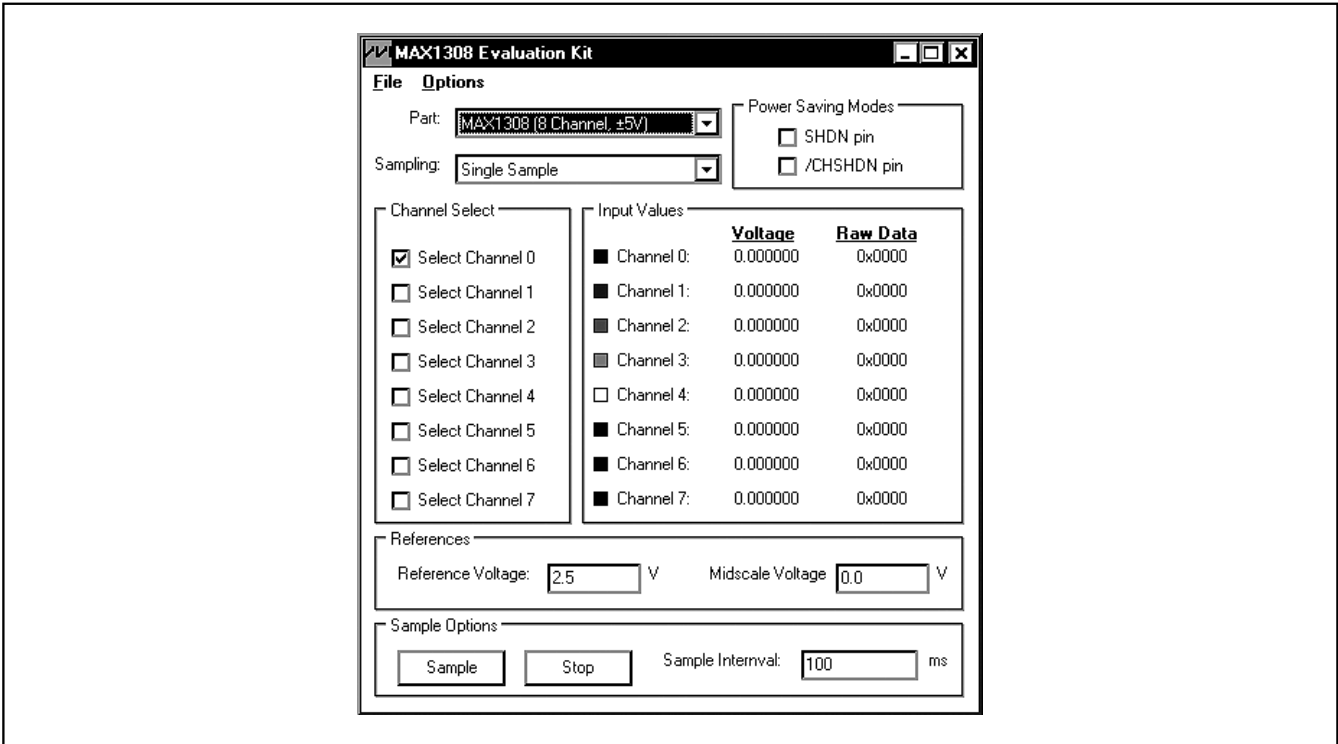


Figure 2. MAX1308 Evaluation Software

MAX1308 Evaluation Kit/Evaluation System

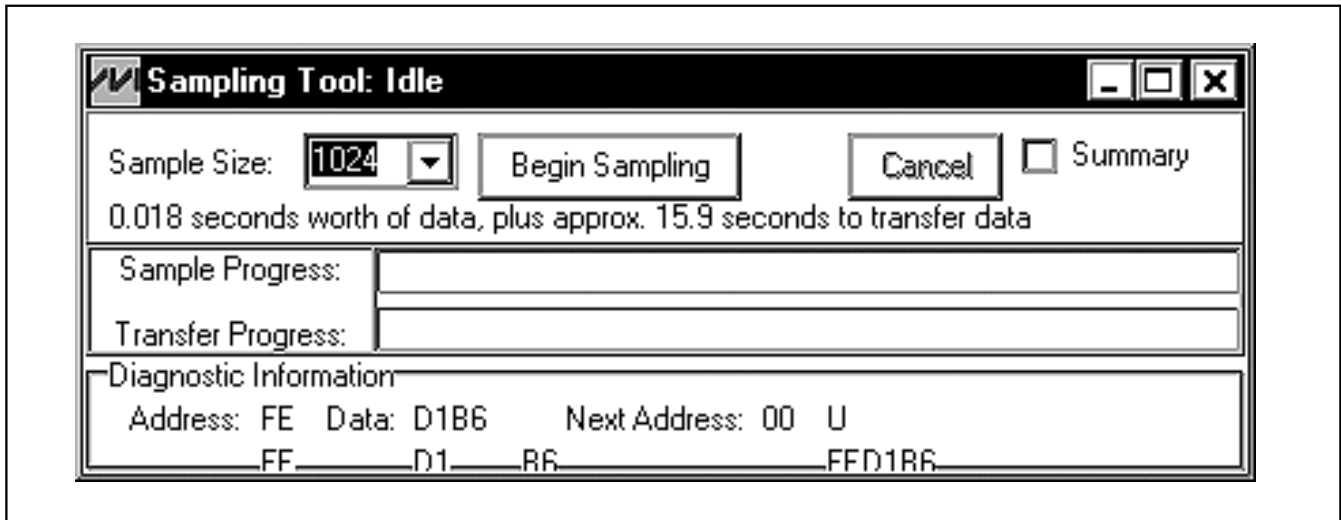


Figure 3. MAX1308 EV Kit Sampling Tool

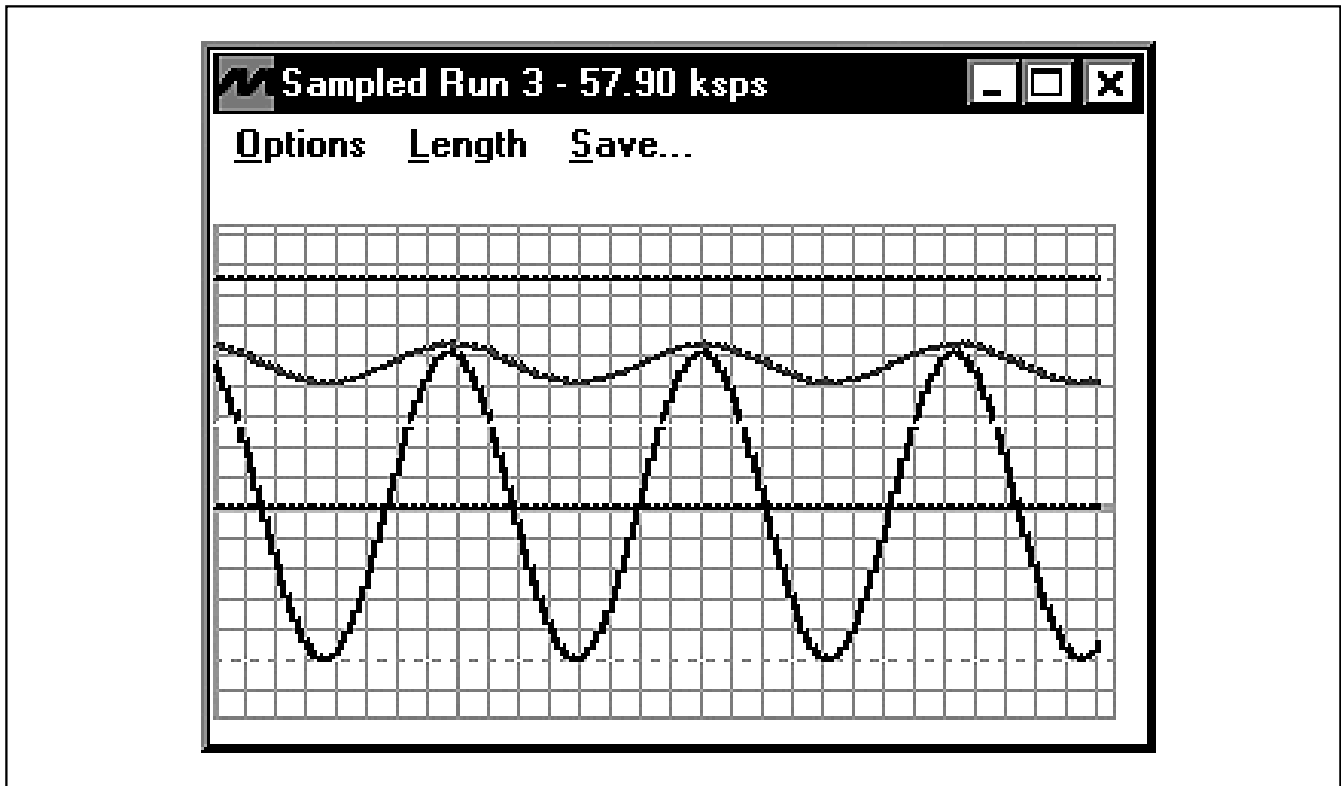


Figure 4. MAX1308 EV Kit Graph Form

MAX1308 Evaluation Kit/Evaluation System

The input buffers require a +5.5V positive supply (HVAVCC) and a -5.5V negative supply (HVAVEE). The positive supply for the input buffers must be applied on the HVAVCC pad or connected to AVDD using JU16. The negative supply must be applied on the HVAVEE pad. Connect the ground for these supplies to the AGND pad.

Jumpers on the EV kit allow evaluation of all the parts in the MAX1304–MAX1315 family. When changing between parts in the family, JU1 and JU13 must be set according to whether the IC accepts bipolar or unipolar inputs.

If the IC has less than eight input channels (i.e., four channels or two channels), the unused input pins can be connected to AGND or left floating. Note that if the inputs are buffered and exceed $\pm 5V$ (i.e., when using the MAX1312–MAX1315 that support inputs up to $\pm 10V$), replace the MAX4351 buffers (U2–U5) with buffers capable of $\pm 10V$ voltage range.

The MAX1308 on the EV kit uses the on-board MAX6126 2.5V reference instead of its internal reference when shipped. To use the MAX1308's internal 2.5V reference, remove the shunt from JU2. The user can also use an external reference by first removing the shunt from JU2 and applying the reference voltage to the REF pad. When using a non-default reference value, the user must update the value in the EV kit software's **References** box.

A logic analyzer can be used instead of the 68HC16MOD-16WIDE to evaluate the MAX1308 EV kit. For this configuration, disconnect the EV kit from the 68HC16MOD-16WIDE and connect the logic analyzer to J1 and J2. These headers allow access to the MAX1308 control (J1) and data (J2) pins.

When shipped, the MAX1308 EV kit is set to use the MAX1308 internal clock, but an external clock can be supported. To use an external clock, connect the clock signal to the ECLK SMA connector, remove the shunt from JU4, and set the shunt on JU14 to the 2-3 position. In this configuration, the 68HC16MOD-16WIDE can no longer be used and the user must supply a parallel interface (i.e., a logic analyzer).

When not using the 68HC16MOD-16WIDE as the parallel interface, the MAX1308 EV kit can be put into autoread mode by placing a jumper on pins 1-2 of JU3. In this mode, the MAX1308 \overline{EOC} pin is connected to the \overline{RD} strobe and available samples are immediately outputted on the parallel bus. When performing autoread, the \overline{CS} pin can be connected low by placing a jumper between J1-9 and J1-10.

Note that when the 68HC16MOD-16WIDE is not being used as the parallel interface, JU15 must be set to the

1-2 position and DVDD must be supplied between the DVDD and DGND pads on the EV kit.

Jumper Selection Tables

The following tables (Tables 1–9) explain the functionality of each jumper on the MAX1308 EV kit.

Table 1. Midscale Voltage Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	Short*	Midscale voltage is set for bipolar inputs.
	Open	Midscale voltage is set for unipolar inputs.

*Default configuration.

Table 2. Reference Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU2	Short*	Select on-board 2.5V reference (MAX6126) as voltage reference.
	Open	Select internal 2.5V reference or external REF pad as voltage reference. Note that external reference must be between 2V and 3V.

*Default configuration.

Table 3. Autoread Mode

JUMPER	SHUNT POSITION	DESCRIPTION
JU3	Short	Connects \overline{RD} and \overline{EOC} lines for autoread mode.
	Open*	Disables autoread mode.

*Default configuration.

Table 4. ADC Clock-Source Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU4	Short*	Select internal clock as ADC system clock.
	Open	Select external ECLK SMA as ADC system clock.

*Default configuration.

MAX1308 Evaluation Kit/Evaluation System

Table 5. Buffered Input Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU5–JU12	Short*	Channel X (where X is determined by the jumper number minus 5) input must appear on CHX-BUF pads and is buffered using the MAX4351.
	Open	Channel X (where X is determined by the jumper number minus 5) input must appear on CHX pads and is not buffered.

*Default configuration.

Table 6. Midscale Reference Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU13	1-2	Midscale reference is set for unipolar inputs.
	2-3*	Midscale reference is set for bipolar inputs.

*Default configuration.

Table 7. ADC System Clock Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU14	1-2*	Select internal clock as ADC system clock.
	2-3	Select external ECLK SMA as ADC system clock.

*Default configuration.

Table 8. DVDD Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU15	1-2	DVDD supplied from DVDD pad.
	2-3*	DVDD connected to VCC supply from 68HC16MOD-16WIDE.

*Default configuration.

Table 9. Positive Supply for Input Buffers (HVAVCC) Select

JUMPER	SHUNT POSITION	DESCRIPTION
JU16	1-2	Positive supply to input buffers connected to AVDD.
	2-3*	Positive supply to input buffers connected to HVAVCC pad.
	Open	No positive supply to input buffers.

*Default configuration.

General Troubleshooting

Problem 1: 68HC16MOD-16WIDE not found (see Figure 5).

- Is LED1 on the 68HC16MOD-16WIDE lit?
- Is the power supply connected?
- Is SW1 turned to ON position?
- Is the DB9 serial-communications cable connected? (if using the USBTO232, is the USB cable connected?)
- Could another application be using the COM port (virtual COM port) (i.e., PDA software)?

Problem 2: Cannot read data from MAX1308 EV kit.

- Are JU5–JU12 set for buffered or unbuffered inputs?
- Are the buffer power supplies (HVAVCC and HVAVEE) connected?
- Are the MAX1308 EV kit power supplies (AVDD and DVDD) connected?
- Are JU4 and JU14 set for internal or external clock?
- Is the part in shutdown mode?

Problem 3: Data being read from the MAX1308 seems incorrect.

- Are JU1 and JU13 set for bipolar or unipolar inputs?
- Is the reference voltage entered correctly in the MAX1308 evaluation software?
- Is the midscale voltage entered correctly in the MAX1308 evaluation software?
- Is the correct part selected in the MAX1308 evaluation software?
- Is the source impedance less than 100Ω?

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

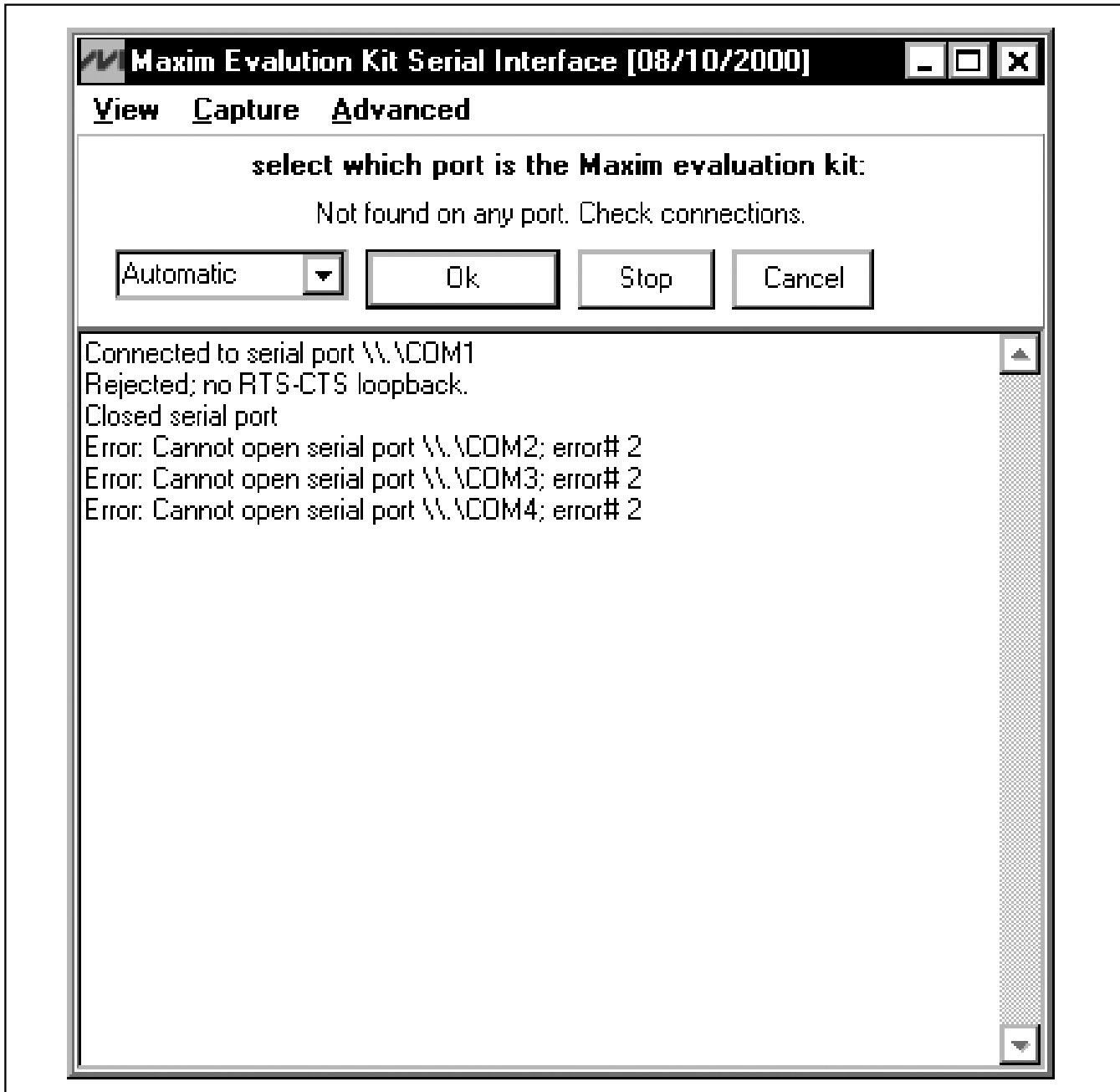


Figure 5. 68HC16MOD-16WIDE Not-Found Error Message

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

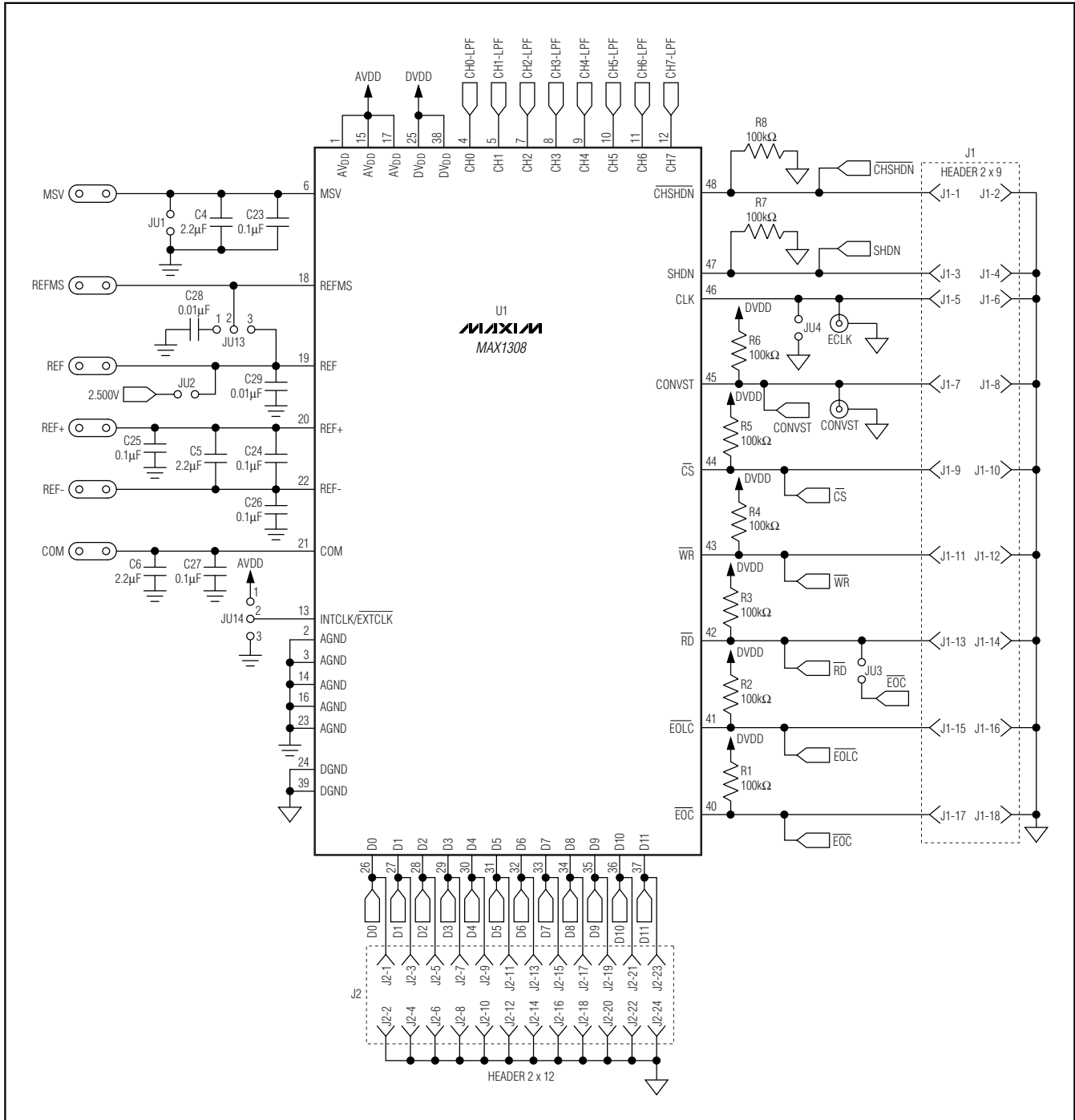


Figure 6. MAX1308 EV Kit Schematic (Sheet 1 of 3)

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

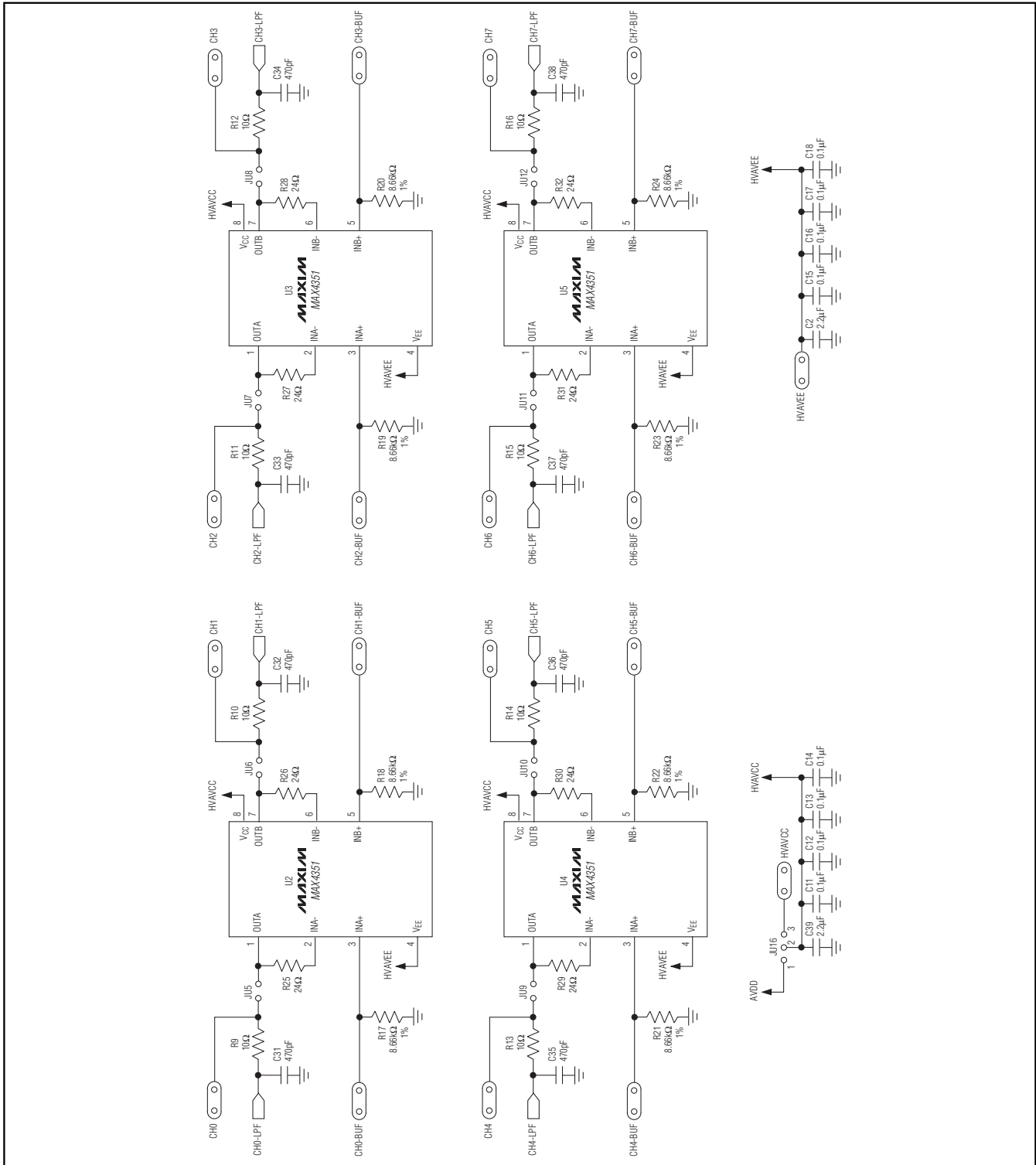


Figure 6. MAX1308 EV Kit Schematic (Sheet 2 of 3)

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

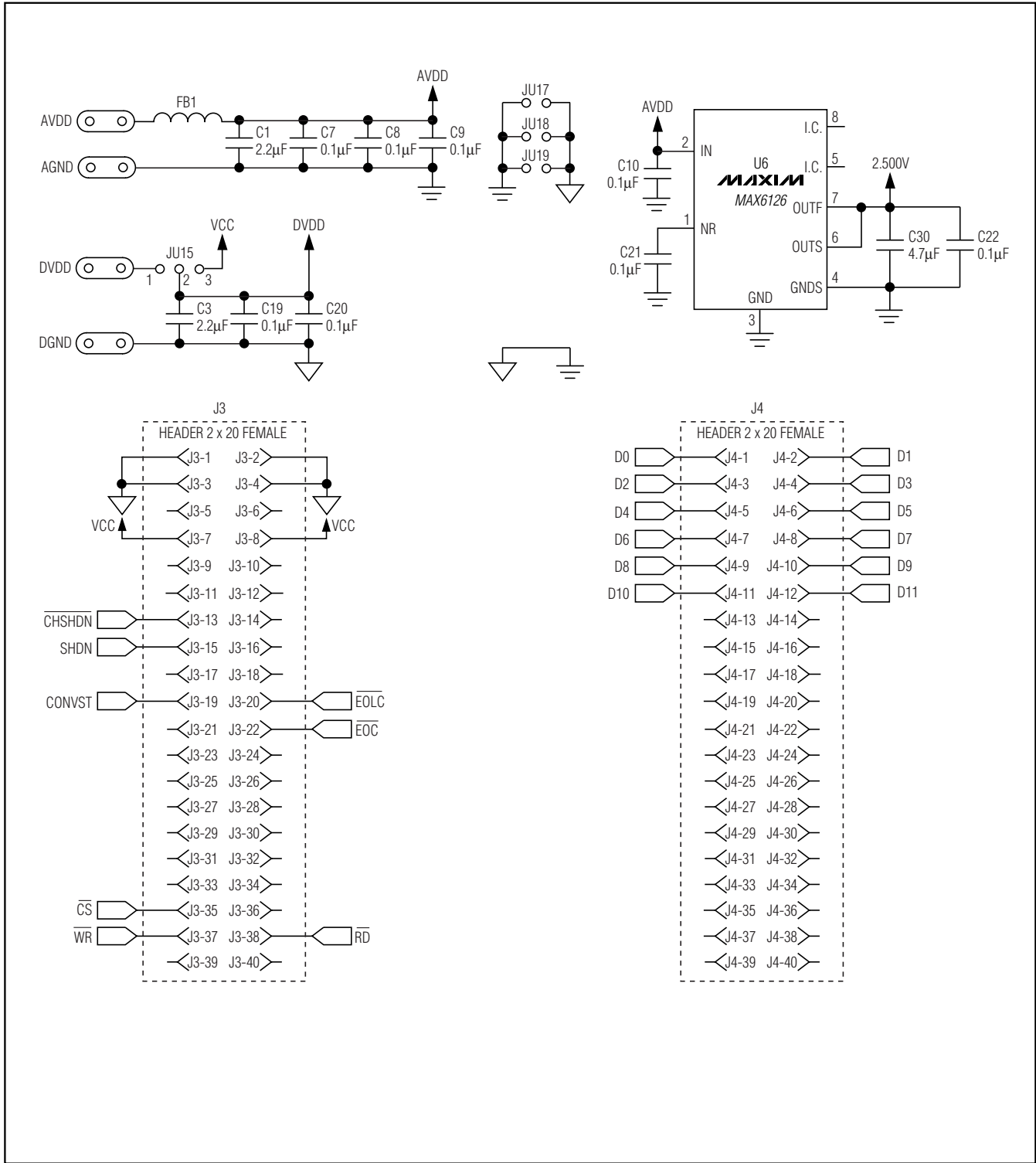


Figure 6. MAX1308 EV Kit Schematic (Sheet 3 of 3)

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

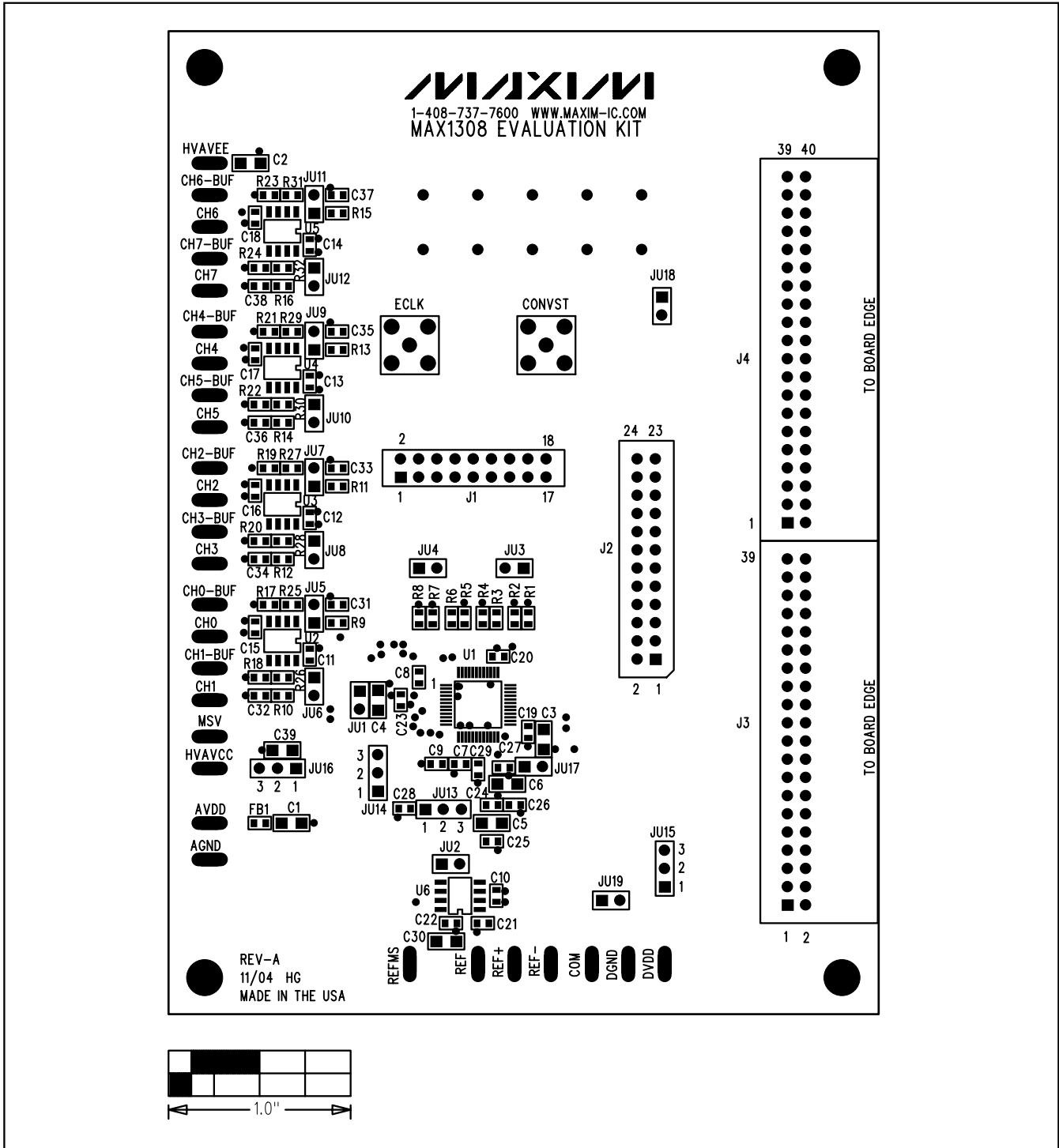


Figure 7. MAX1308 EV Kit Component Placement Guide—Component Side

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

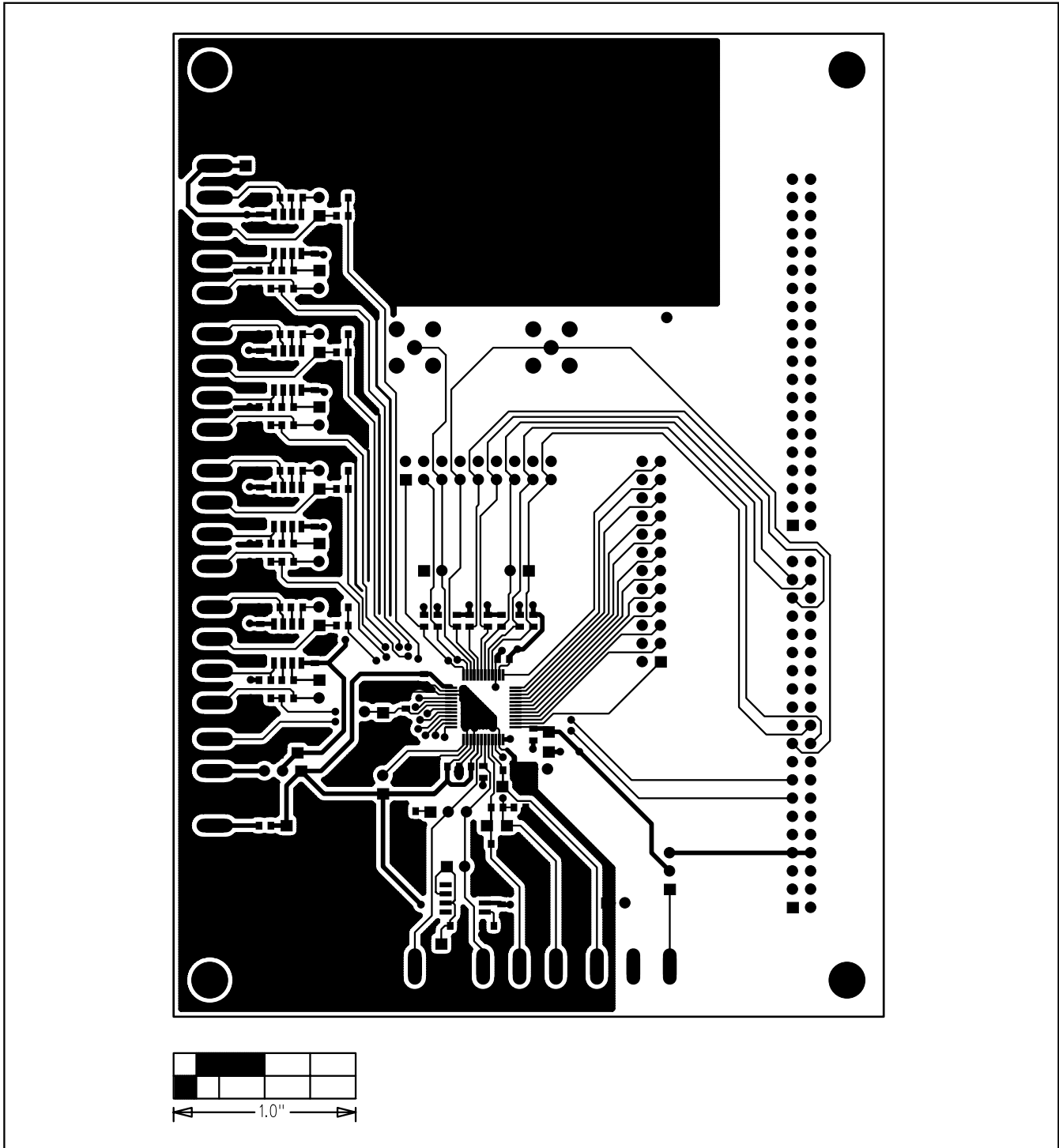


Figure 8. MAX1308 EV Kit PCB Layout—Component Side

MAX1308 Evaluation Kit/Evaluation System

Evaluate: MAX1304-MAX1315

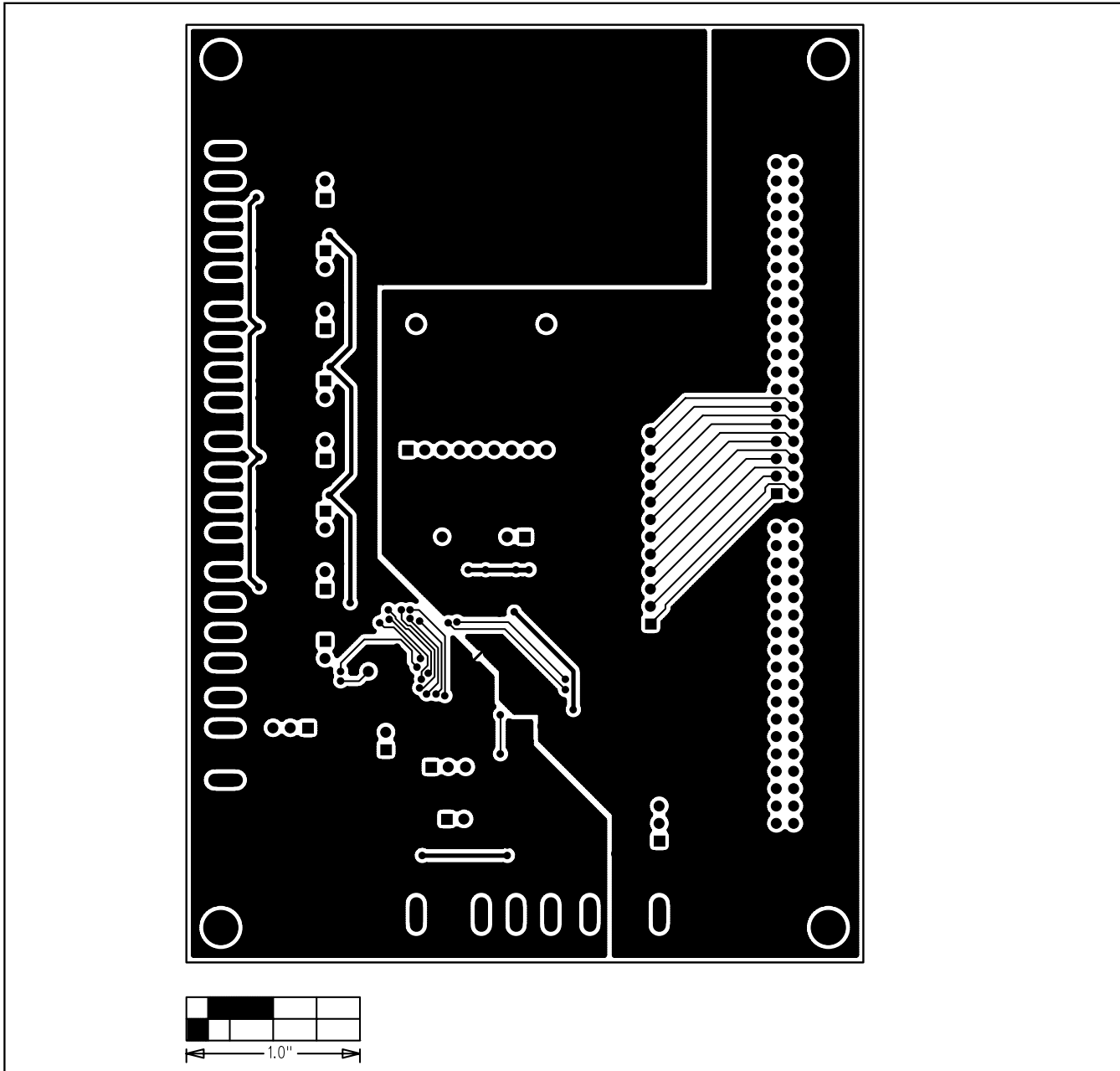


Figure 9. MAX1308 EV Kit PCB Layout—Solder Side

Revision History

Pages changed at Rev 1: 1-14

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600 _____ 15

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



Тел: +7 (812) 336 43 04 (многоканальный)
Email: org@lifeelectronics.ru