19-5958; Rev 0; 6/11

MAX9599 Evaluation Kit
Evaluates: MAX9599

General Description

The MAX9599 evaluation kit (EV kit) demonstrates the MAX9599 multiple programmable reference voltages for gamma correction in TFT-LCD panels such as those found in notebook and tablet displays. The device has multiple-time-programmable (MTP) memory to store the reference data and all the gamma output codes (14 channels). This feature can be demonstrated through the EV kit software.

The EV kit is configured to operate entirely from the USB power and thus no external supply is required. For current measurements or isolated supplies, jumpers are provided for a user-supplied power source.

The EV kit features a USB-to-I²C interface circuit. The EV kit features Windows XP®-, Windows Vista®-, and Windows® 7-compatible software with a graphical user interface (GUI) for exercising the features of the device. The EV kit can also connect to a user-supplied I²C interface circuit for stand-alone operation.

Features

- **14 Channels of Programmable Gamma Voltages with 10-Bit Resolution**
- **Programmable Reference for Gammas**
- **MTP Memory to Store Gamma and Reference Codes**
- **USB-Powered (Cable Included)**
- **Windows XP-, Windows Vista-, and Windows 7-Compatible Software**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

***Ordering Information* appears at end of data sheet.**

Component List

DESIGNATION	QTY	DESCRIPTION
AVDD, DVDD, VBUS, +2.5V, +8V, +18V	6	Red multipurpose test points (63 mil drill size)
C1–C14	0	Not installed, ceramic capacitors (0603)
C15, C17, C19, C25, C27–C30, C32, C33, C34, C44	12	0.1µF ±10%, 50V X5R ceramic capacitors (0603) Murata GRM188R61H104K
C16	1	10µF ±10%, 35V X7R ceramic capacitor (1210) Murata GRM32ER7YA106K
C18, C20, C23, C50	4	10µF ±10%, 25V X5R ceramic capacitors (1206) Murata GRM31CR61E106K
C21, C31, C40, C41, C46, C48	6	1µF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C105K
C22, C49	2	1000pF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H102K
C26	1	4.7µF ±10%, 6.3V X5R ceramic capacitor (0603) Murata GRM188R60J475K
C35, C36	2	10pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H100J
C37	1	0.033µF ±10%, 25V X7R ceramic capacitor (0603) Murata GRM188R71E333K
C38, C39	2	22pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J
C45, C47	2	10µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J106M
D1	1	Green LED (0603)
D2, D3	2	30V, 1A Schottky diodes (SOD123) Diodes Inc. B130LAW-7_F
GND	2	Black multipurpose test points (63 mil drill size)
H1	0	Not installed, 34-pin (2 x 17) header
H2	0	Not installed, 14-pin (2 x 7) header

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
JU1, JU2, JU3	3	3-pin headers
JU4–JU7	4	2-pin headers
JU8, JU9	0	Not installed, 2-pin headers
L1, L2	2	47µH, 170mA inductors (1210) Murata LQH32CN470K23L
PL_GMA1–PL_GMA14	0	Not installed, miniature test points
R1–R14	14	0Ω ±5% resistors (0603)
R15–R29	0	Not installed, resistors (0603)
R30, R31	2	1kΩ ±5% resistors (0603)
R32	1	54.9kΩ ±1% resistor (0603)
R33, R46	2	10.2kΩ ±1% resistors (0603)
R36, R37	2	27Ω ±5% resistors (0603)
R38	1	1.5kΩ ±5% resistor (0603)
R43	1	220Ω ±5% resistor (0603)
R45	1	137kΩ ±1% resistor (0603)
U1	1	Programmable gamma buffers (24 TQFN-EP) Maxim MAX9599ETG+
U2	1	Microcontroller (68 QFN-EP) Maxim MAXQ2000-RAX+
U3, U7	2	30V boost converters (6 TDFN-EP) Maxim MAX1605ETT+
U4	1	UART-to-USB converter (32 TQFP) FT232BL
U5	1	3.3V, 120mA regulator (5 SC70) Maxim MAX8511EXK33+
U6	1	2.5V, 120mA regulator (5 SC70) Maxim MAX8511EXK25+
U8	1	Level translator (10 µMAX®) Maxim MAX1840EUB+
USB	1	USB type-B right-angle PC-mount receptacle
Y1	1	16MHz crystal (HCM49) Hong Kong X'tals SSM16000N1HK188F0-0
Y2	1	6MHz crystal (HCM49) Hong Kong X'tals SSL60000N1HK188F0-0
—	7	Shunts (JU1–JU7)
—	1	PCB: MAX9599 EVALUATION KIT

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Diodes Incorporated	805-446-4800	www.diodes.com
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com

Note: *Indicate that you are using the MAX9599 when contacting these component suppliers.*

MAX9599 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX9599.EXE	Application program
CDM20600.EXE	Installs the USB device driver
UNINSTALL.EXE	Uninstalls the EV kit software
USB_Driver_Help_200.PDF	USB driver installation help file

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Quick Start

Required Equipment

- MAX9599 EV kit (USB cable included)
- User-supplied Windows XP, Windows Vista, or Windows 7 PC with a spare USB port
- Digital voltmeter (DVM)

Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software. Text in **bold and underlined** refers to items from the Windows operating system.

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation:

1) Visit **www.maxim-ic.com/evkitsoftware** to download the latest version of the EV kit software, 9599Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.
2) Install the EV kit software and USB driver on your computer by running the INSTALL.EXE program inside the temporary folder. The program files are copied to your PC and icons are created in the Windows **Start | Programs** menu. During software installation, some versions of Windows may show a warning message indicating that this software is from an unknown publisher. This is not an error condition and it is safe to proceed with installation. Administrator privileges are required to install the USB device driver on Windows.
3) Verify that all jumpers are in their default positions, as shown in Table 1.
4) Connect the USB cable from the PC to the EV kit board. A Windows message appears when connecting the EV kit board to the PC for the first time. Each version of Windows has a slightly different message. If you see a Windows message stating **ready to use**, then proceed to the next step; otherwise, open the USB_Driver_Help_200.PDF document in the Windows **Start | Programs** menu to verify that the USB driver was installed successfully.
5) Start the EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software main window appears, as shown in Figure 1.
6) Connect the DVM negative terminal to an GND PCB pad on the EV kit and use the positive terminal of the DVM to measure the gamma output voltage on the PL_GMA1 test point.
7) Adjust the **Ch1** scrollbar to the desired output voltage.
8) Verify that the PL_GMA1 output voltage is close to the voltage shown in the **Ch1 Output (V)** edit box.
9) Repeat for other channels.

Detailed Description of Software

The main window of the MAX9599 EV kit software (Figure 1) displays the register values and output voltages for the programmable reference voltage and all DAC channels. Other features include DAC and MTP output selection, register addressing mode, saving, and loading register values.

Reference

The device features a programmable reference voltage. The voltage can be adjusted by moving the scrollbar, typing into the **Reg Value** or **Output (V)** edit boxes within the **Reference** group box.

Output Select

The **Output Select** group box determines where the gamma output codes are sent. The gamma output codes can be sent to the DAC, or stored in the MTP memory for later use. Select the **DAC** radio button to send the codes directly to the gamma buffer; select the **MTP** radio button to store the codes in the MTP memory.

Register Addressing Mode

The **Register Addressing Mode** group box determines how the register values are written to the device's gamma channels. The register values can be written individually, or to the reference and all 14 channels simultaneously. Select the **Single** radio button to write to an individual channel. Select the **Burst** radio button to write to the reference and all 14 channels simultaneously.

DAC Channels

Each DAC channel's register value can be set in three different ways within the **DAC Channels** group box as follows:

1) Moving the channel's scrollbar.
2) Typing register values directly into the channel's **Reg Value** edit box (decimal 10-bit equivalent).
3) Typing the expected output voltage in the channel's **Output (V)** edit box. The software uses a register value that generates a voltage closest to the desired voltage value.

When the **DAC** and **Single** radio buttons are selected (Figure 1), the steps above change its register value instantaneously. When the **DAC** and **Burst** radio buttons are selected, the **Load All Values To Registers** button is enabled. When a register value is changed, the corresponding field changes its color to red. A user must synchronize the GUI fields and actual device registers by pressing the **Load All Values To Registers** button.

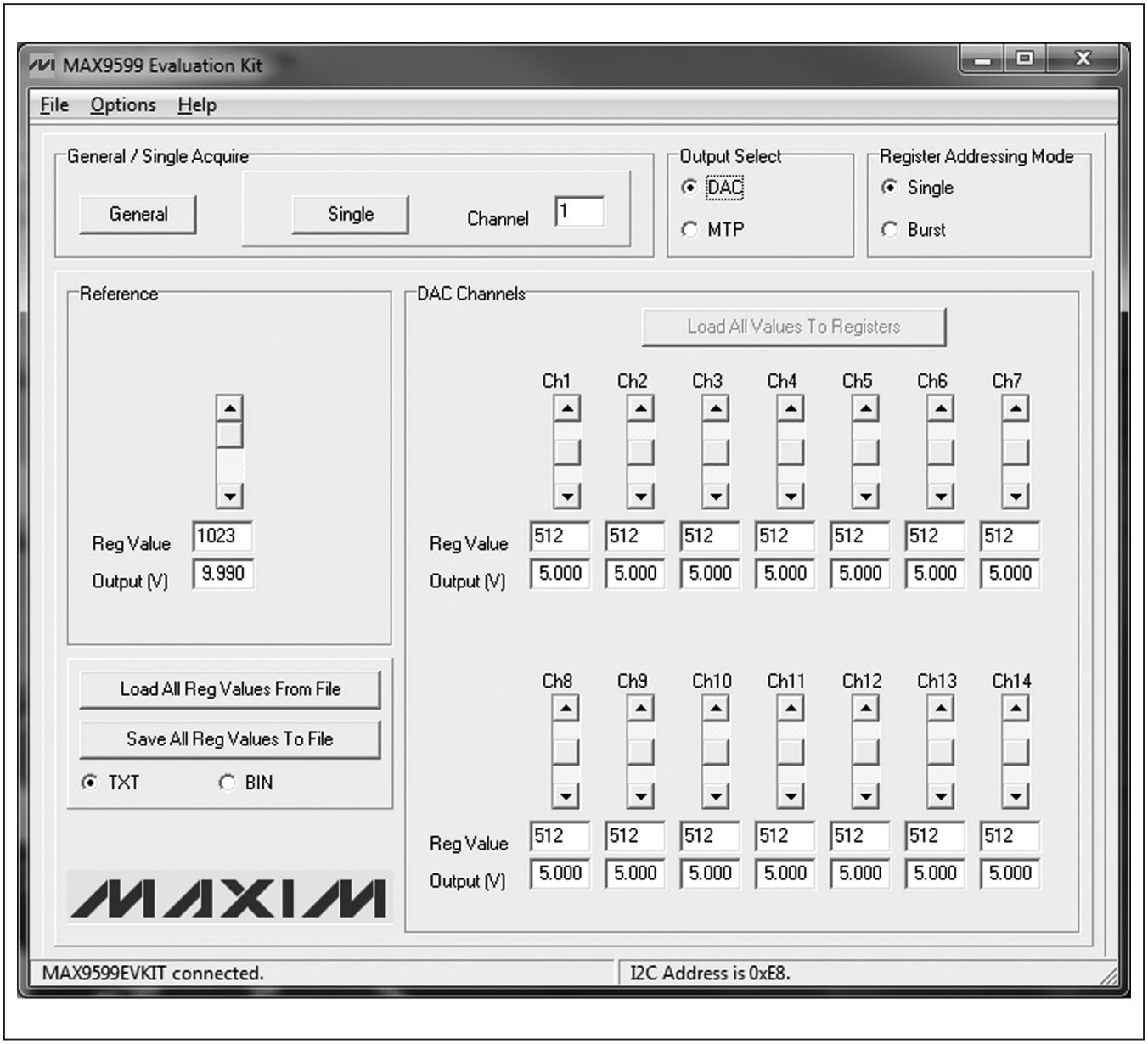

Figure 1. MAX9599 Evaluation Software Main Window (DAC and Single Radio Button Selection)

When the **MTP** and **Single** radio buttons are selected (Figure 2), the individual **Burn** buttons are enabled. Press the corresponding **Burn** button once the desire changes are made to write to the MTP memory.

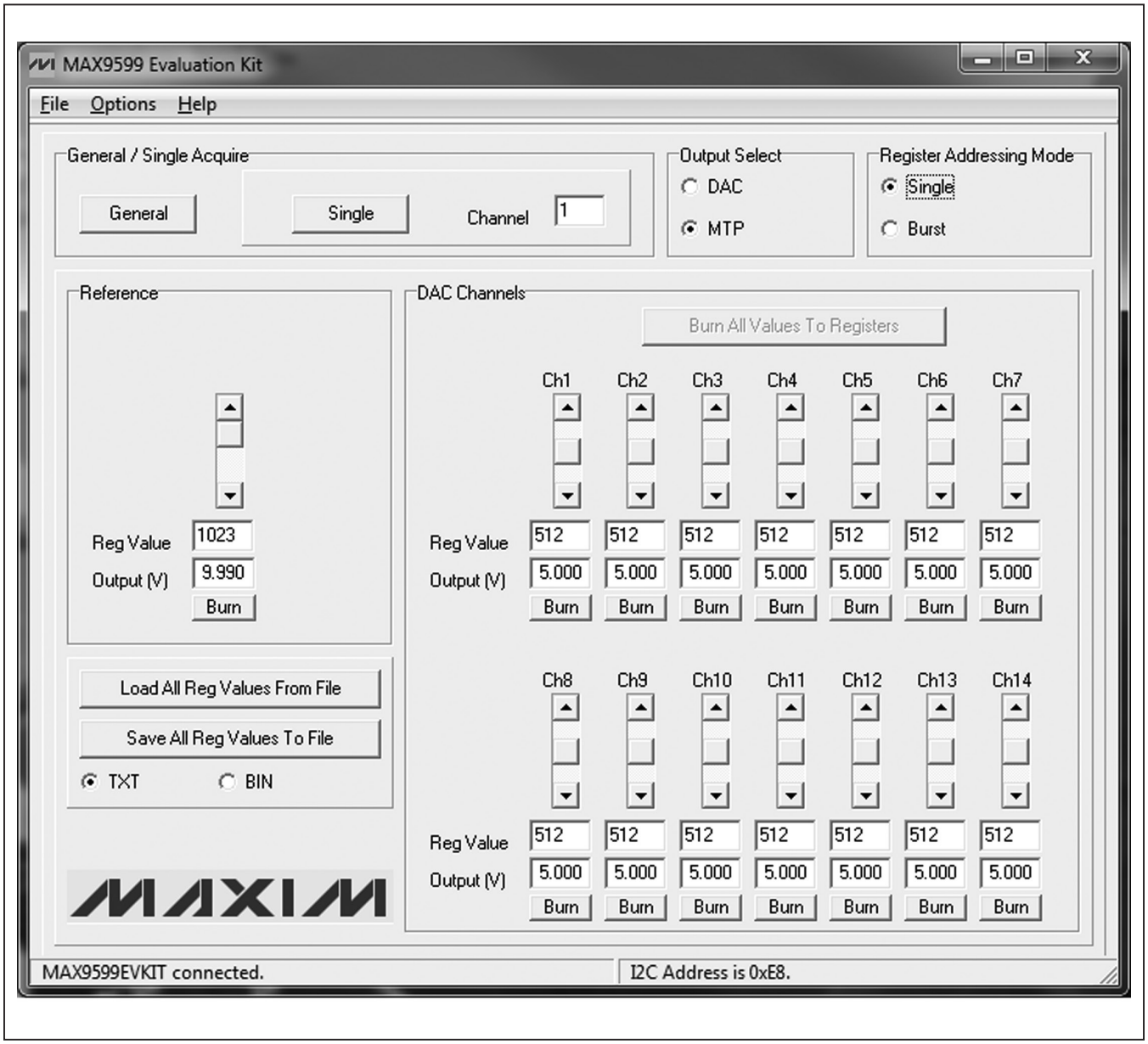

Figure 2. MAX9599 Evaluation Software Main Window (MTP and Single Radio Button Selection)

When the **MTP** and **Burst** radio buttons are selected (Figure 3), the **Burn All Values To Registers** button is enabled. When a register value is changed, the corresponding field changes its color to red. A user must synchronize the GUI fields and actual device registers by pressing the **Burn All Values To Registers** button.

Loading and Saving Register Values

The **Load All Reg Values From File** button is used to load all the register values from a text or binary file. The **Save All Reg Values To File** button is used to save all the register values on the current GUI to a text or binary file. Use the **TXT** or **BIN** radio button to select between text and binary file format.

Loading MTP Values

The **General / Single Acquire** group box is used to update the programmable reference voltage and the DAC channels with values that are stored in MTP memory. Pressing the **General** button updates the programmable reference voltage and the DAC channels with the MTP values. Pressing the **Single** button updates the channel corresponding to the **Channel** edit box. Entering **0** recalls the programmable reference voltage and entering **1** through **14** recalls the corresponding DAC channel.

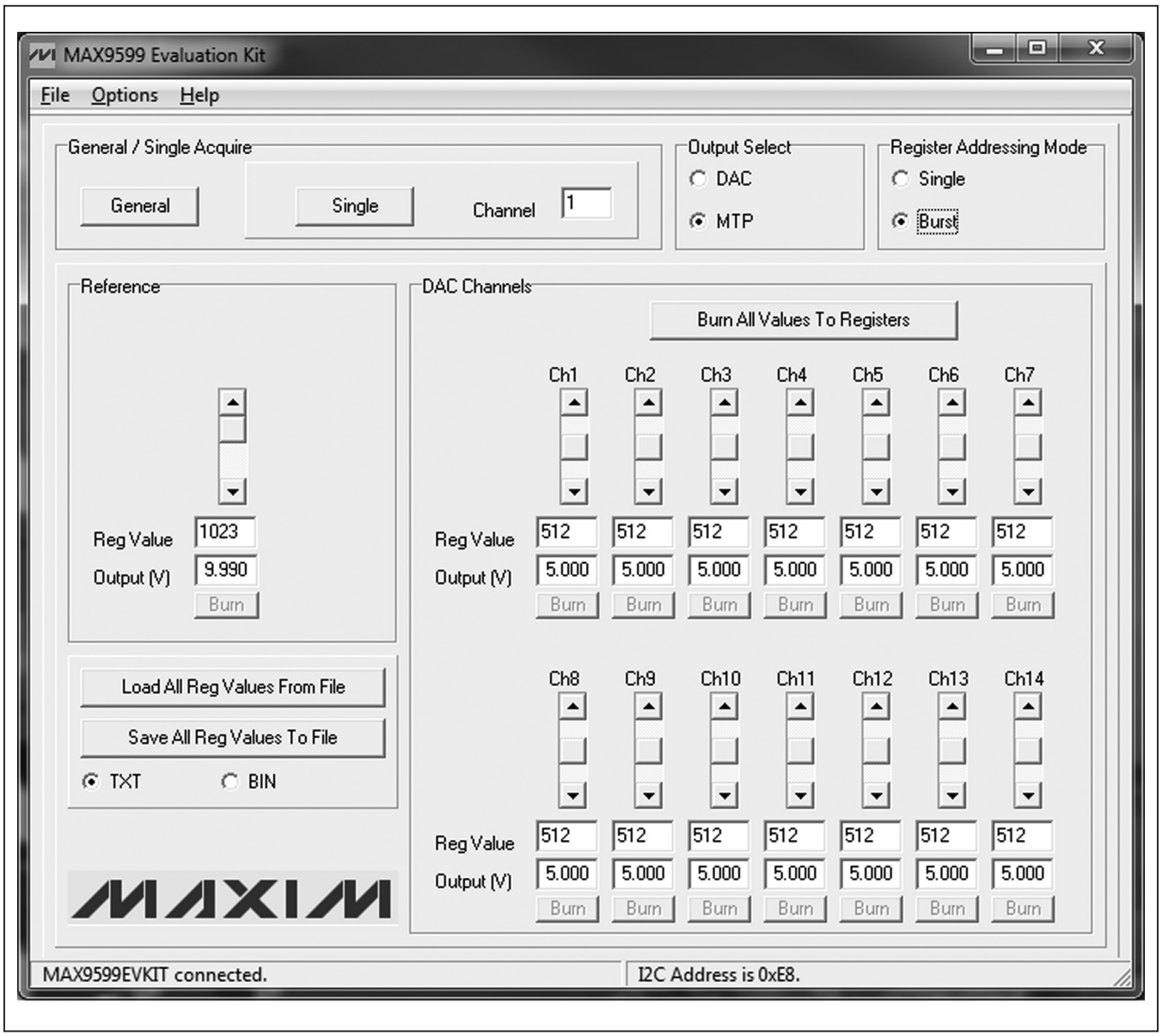

Figure 3. MAX9599 Evaluation Software Main Window (MTP and Burst Radio Button Selection)

Advanced User Interface

There are two methods for communicating with the device. The first is through the windows shown in Figures 1, 2, and 3. The second is through the **Advanced User Interface** window shown in Figure 4. **The Advanced User Interface** window becomes available by selecting the **Options I Interface (Advanced User)** menu item and allows execution of serial commands manually.

The **Advanced User Interface** window can also be used as a debug tool since it is capable of manually reading and writing to every register of the device.

Detailed Description of Hardware

The MAX9599 EV kit demonstrates the MAX9599 programmable reference voltage generator for gamma correction in TFT-LCD panels in a 24-pin TQFN package with an exposed pad. The EV kit provides 14 programmable gamma outputs (DAC outputs) with a programmable DAC reference voltage.

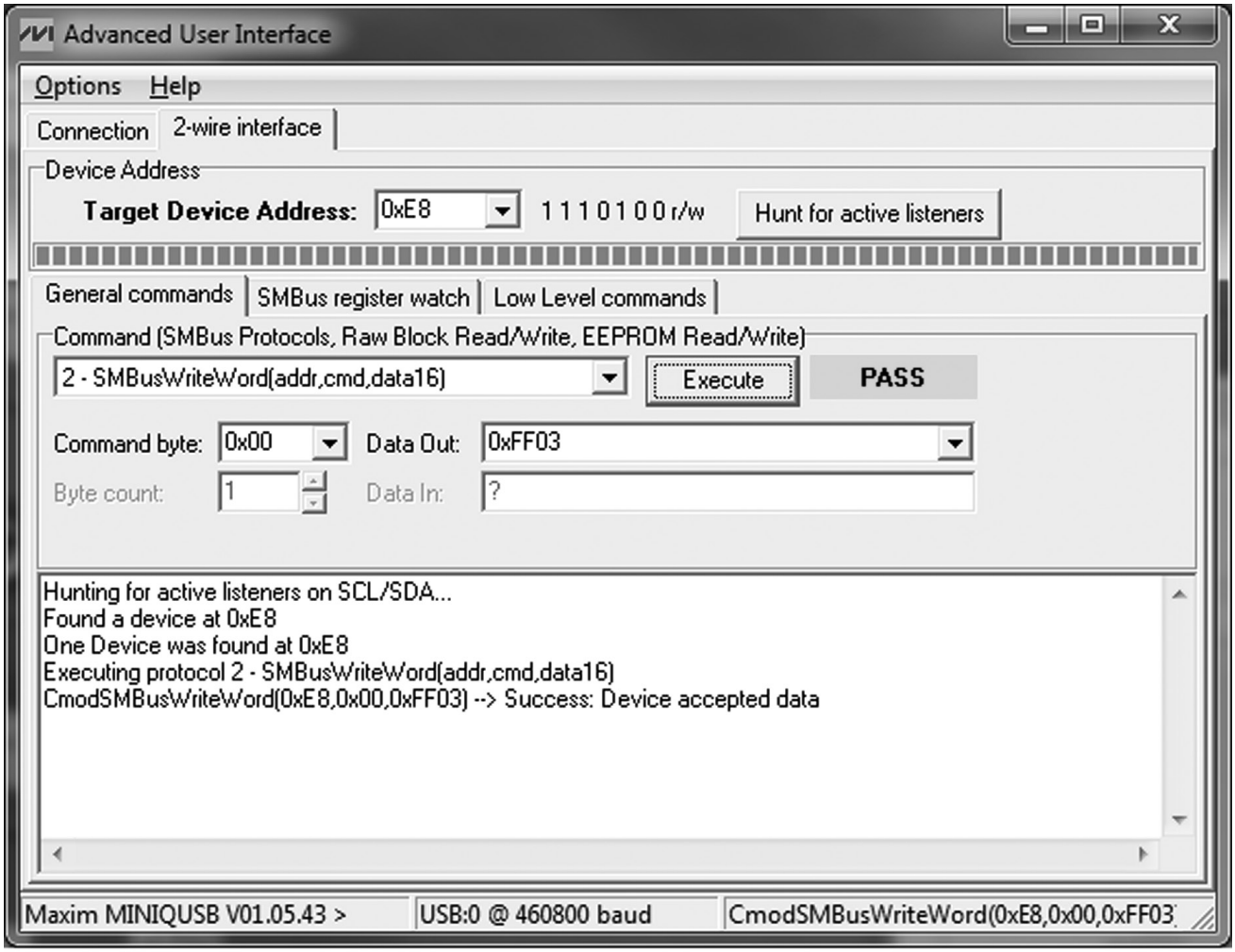

Figure 4. Advanced User Interface Window (2-Wire Interface Tab)

The EV kit uses the USB supply to generate all required supply voltages. Two boost regulators are included on the EV kit circuit that takes the USB power and steps it up to +18V for PGM (program), +8V for AVDD, and +2.5V for DVDD. As the USB power specification is only guaranteed up to 500mW, Maxim does not recommend loading the DAC outputs when using USB power. For load testing of the DAC outputs, user-supplied power for EXT_AVDD, EXT_DVDD, and EXT_PGM are required (see the *User-Supplied Power* section).

User-Supplied Power

The device has three supply inputs (AVDD, DVDD, and PGM) that require powering when the USB power source is not used. The EV kit provides jumpers to separately power each supply. Nominally AVDD is connected to the on-board +8V supply, DVDD is connected to the on-board +2.5V supply, and PGM is connected to the on-board +18V supply. Connect AVDD, DVDD, and PGM to user-supplied power when operating the EV kit under load. See Table 1 for shunt settings that allow user-supplied power.

Stand-Alone User-Supplied I²C Communication

The EV kit can be used in stand-alone operation to interface with a user's I²C system without using a PC. Jumpers JU4–JU7 are for the I²C signals and pullups (R30, R31). The EV kit can be USB powered while an external system communicates over the I²C lines. To use the EV kit with a user-supplied I²C interface, perform the following steps:

1) Remove the shunts from jumpers JU4 and JU5.
2) If the user-supplied I²C interface circuit already includes pullup resistors for SDA and SCL, remove the shunts from jumpers JU6 and JU7.
3) Connect the user-supplied I²C interface signals and signal ground return to the EV kit PCB pads, as shown in Table 2.

Table 1. Jumper Descriptions (JU1–JU7)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	On-board AVDD. Connects AVDD to the on-board +8V supply.
	2-3	User-supplied AVDD. Apply an external supply voltage between the EXT_AVDD and nearest GND PCB pads.
JU2	1-2*	On-board DVDD. Connects DVDD to the on-board +2.5V supply.
	2-3	User-supplied DVDD. Apply an external supply voltage between the EXT_DVDD and nearest GND PCB pads.
JU3	1-2*	On-board PGM. Connects PGM to the on-board +18V supply.
	2-3	User-supplied PGM. Apply an external supply voltage between the EXT_PGM and nearest GND PCB pads.
JU4	Not installed	User-supplied I²C. Apply the SCL signal to the SCL PCB pad.
	Installed*	On-board I²C. Connects the on-board SCL signal to the device. The SCL PCB pad can be used to monitor the signal.
JU5	Not installed	User-supplied I²C. Apply the SDA signal to the SDA PCB pad.
	Installed*	On-board I²C. Connects the on-board SDA signal to the device. The SDA PCB pad can be used to monitor the signal.
JU6	Not installed	User-supplied I²C SCL pullup.
	Installed*	On-board I²C SCL pullup to DVDD through resistor R31.
JU7	Not installed	User-supplied I²C SDA pullup.
	Installed*	On-board I²C SDA pullup to DVDD through resistor R30.

**Default position.*

Table 2. User-Supplied I²C Interface

USER-SUPPLIED SIGNAL	SIGNAL	EV KIT PCB PAD
SDA	I²C data	SDA
SCL	I²C clock	SCL
GND	Signal ground return	GND

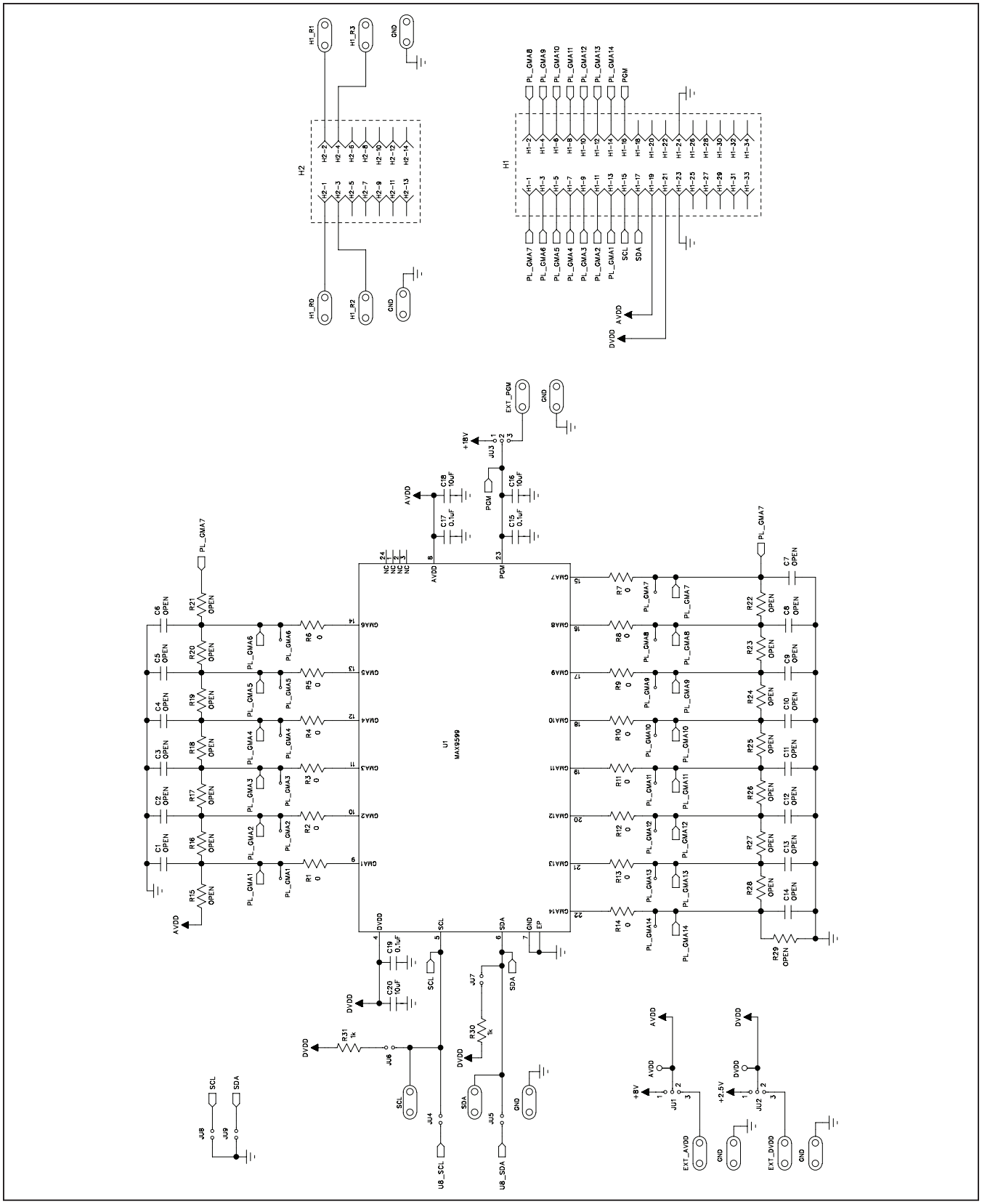

Figure 5a. MAX9599 EV Kit Schematic (Sheet 1 of 2)

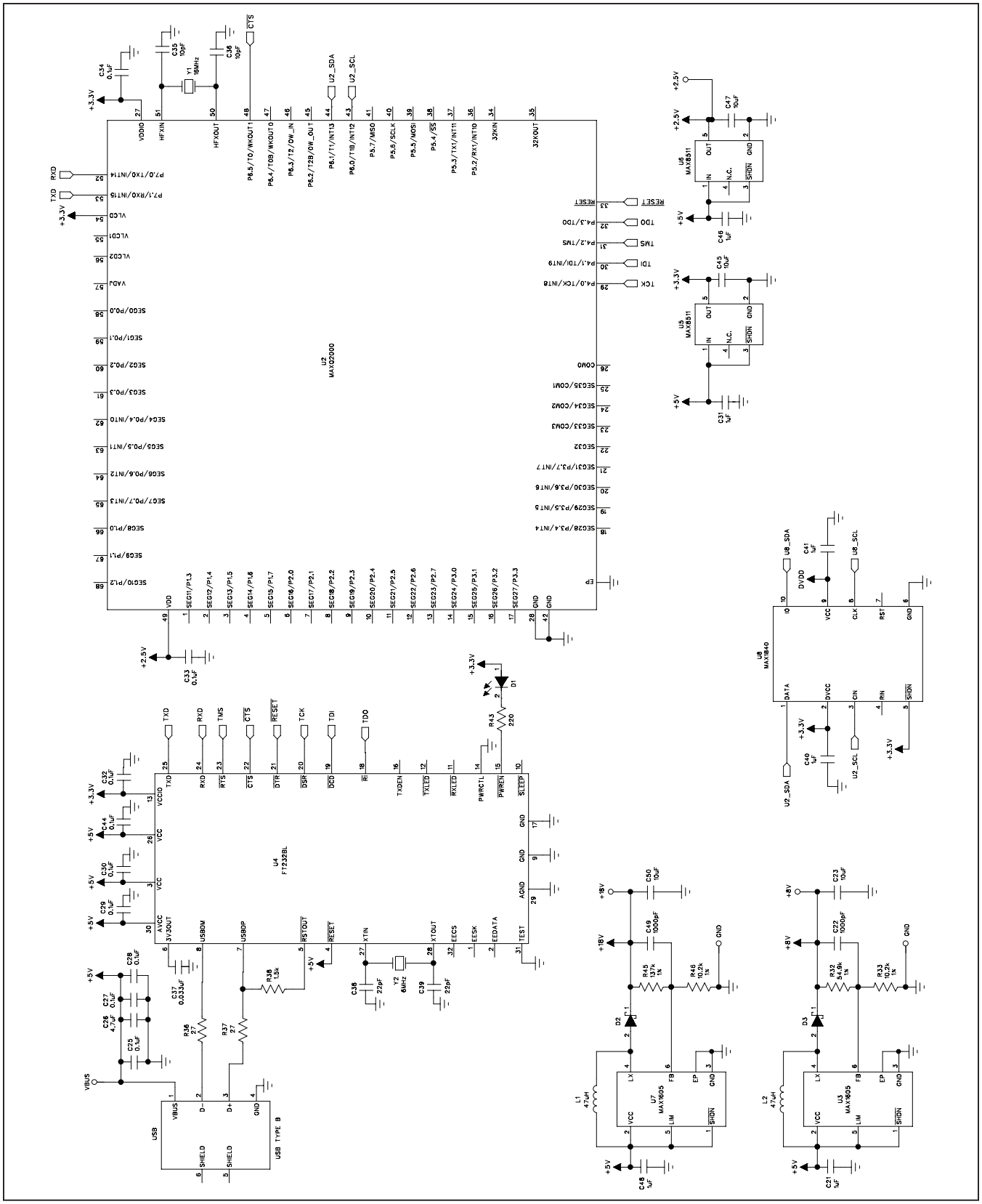

Figure 5b. MAX9599 EV Kit Schematic (Sheet 2 of 2)

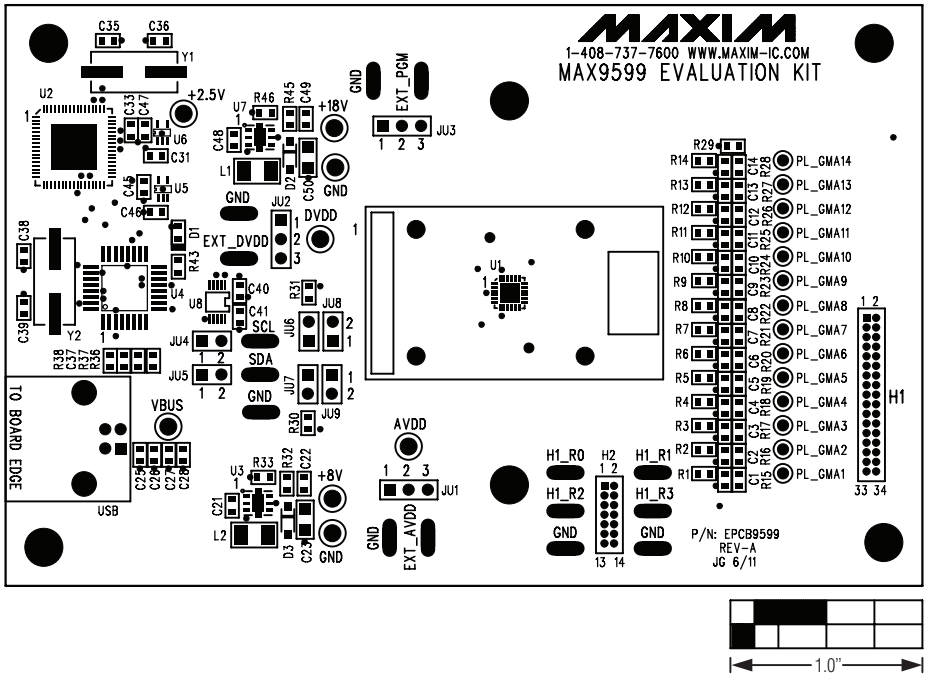

Figure 6. MAX9599 EV Kit Component Placement Guide—Component Side

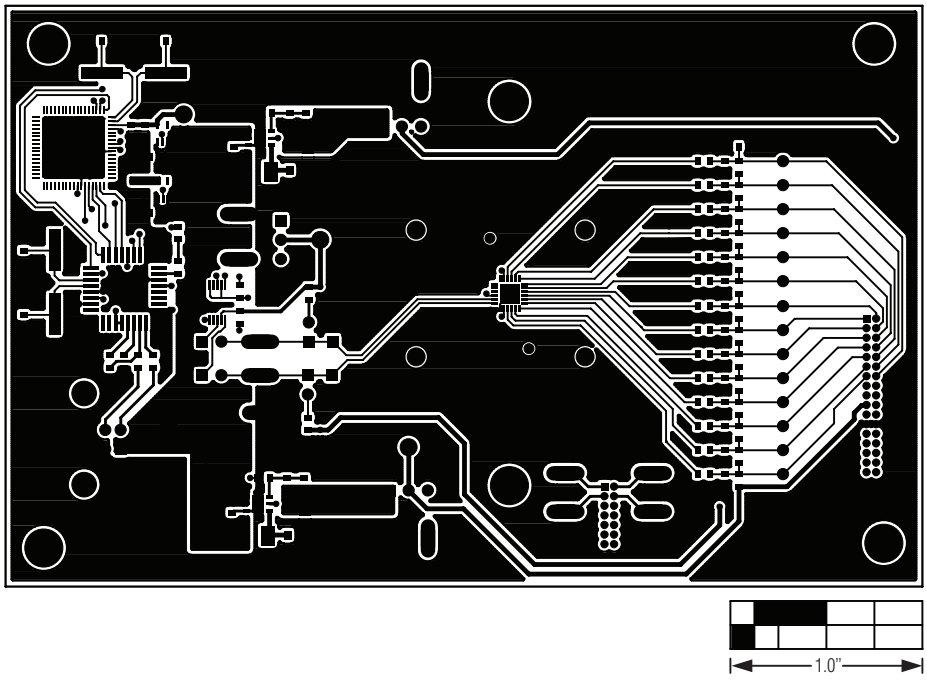

Figure 7. MAX9599 EV Kit PCB Layout—Component Side

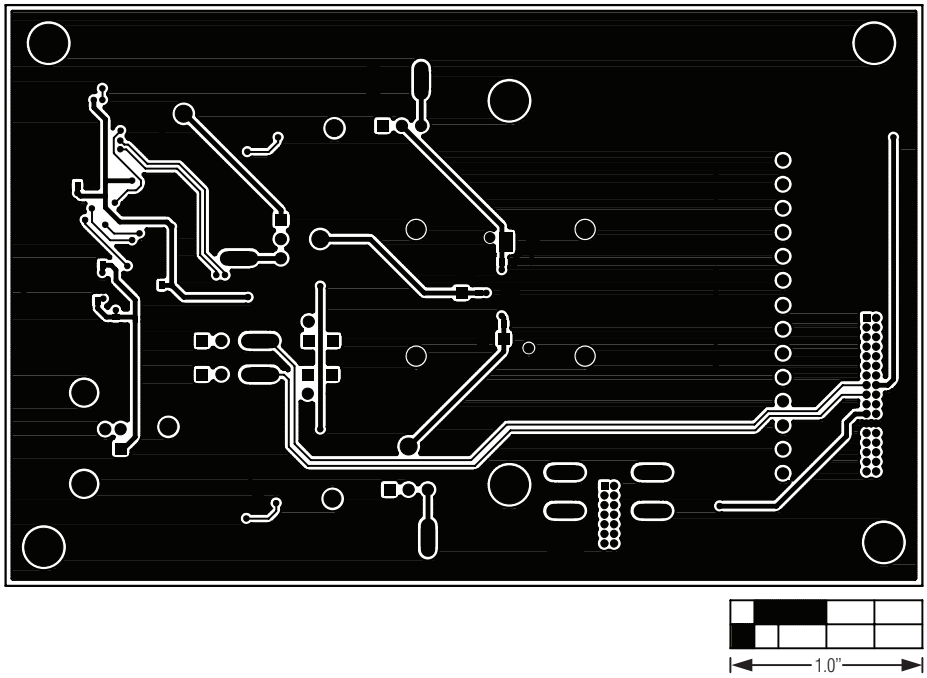

Figure 8. MAX9599 EV Kit PCB Layout—Solder Side

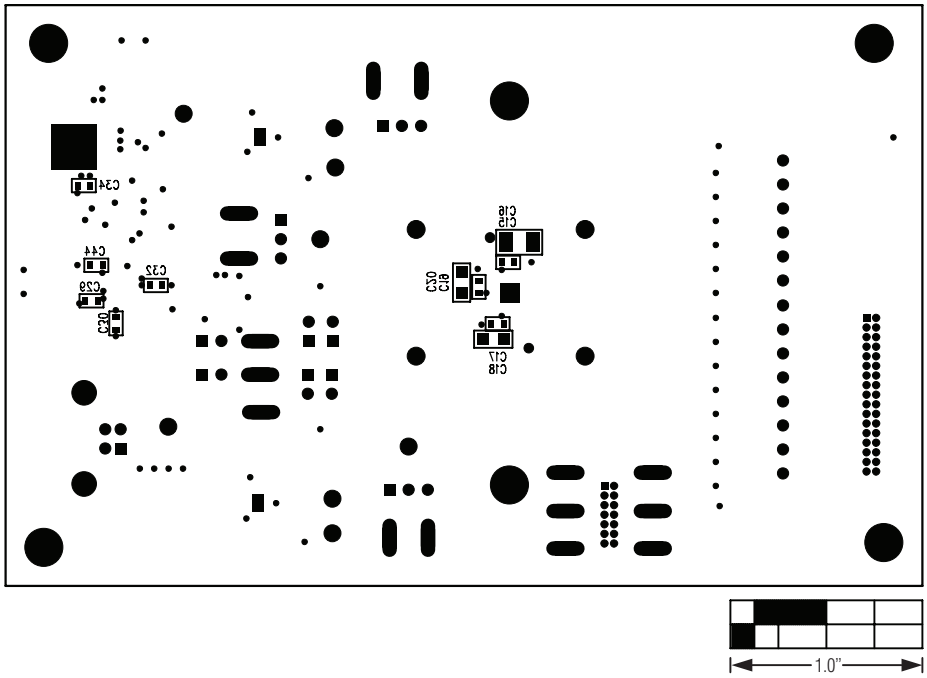

Figure 9. MAX9599 EV Kit Component Placement Guide—Solder Side

Ordering Information

PART	TYPE
MAX9599EVKIT#	EV Kit

#Denotes RoHS-compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/11	Initial release	—