19-5839; Rev 0; 4/11

MAX9263 Evaluation Kit
Evaluates: MAX9263/MAX9264

General Description

The MAX9263 evaluation kit (EV kit) provides a proven design to evaluate the MAX9263 high-bandwidth digital-content protection (HDCP) gigabit multimedia serial link (GMSL) serializer with spread spectrum and full-duplex control channel. The EV kit also includes Windows XP®-, Windows Vista®-, and Windows® 7-compatible software that provides a simple graphical user interface (GUI) for exercising the features of the device.

The EV kit comes with a MAX9263GCB/V+ installed.

For complete GMSL evaluation, order both the MAX9263 EV kit and its companion board, the MAX9264 EV kit.

Features

- **Accepts 29-Bit Parallel Video and I²S Audio**
- **On-Board S/PDIF-to-I²S Audio Converter**
- **Windows XP-, Windows Vista-, and Windows 7-Compatible Software**
- **USB-PC Connection (Cable Included)**
- **USB Powered**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

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

Component List

DESIGNATION	QTY	DESCRIPTION
C1–C7	7	0.01µF ±10%, 25V X7R ceramic capacitors (0402) Murata GRM155R71E103K
C8–C14, C101–C105, C111, C121, C131, C141, C151, C211–C214, C221, C231, C241, C251	25	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K
C15, C16	2	0.22µF ±10%, 50V X7R ceramic capacitors (0805) Murata GRM21BR71H224K
C21, C261	2	4.7µF ±20%, 25V X7R ceramic capacitors (1206) Murata GCM31CR71E475M
C22, C24, C25, C26, C109, C262, C264, C267	8	10µF ±20%, 16V X5R ceramic capacitors (1206) Murata GRM31CR61C106M
C23, C263	0	Not installed, ceramic capacitors (1206)
C106, C107, C122, C123	4	22pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J
C108, C265, C268	3	1µF ±10%, 16V X5R ceramic capacitors (0603) TDK C1608X5R1C105K
C110	1	0.033µF ±10%, 25V X7R ceramic capacitor (0603) Murata GRM188R71E333K
C201, C202, C203	3	1µF ±20%, 6.3V X5R ceramic capacitors (0402) TDK C1005X5R0J105M
C205, C206, C232, C266, C269	5	0.01µF ±5%, 25V C0G ceramic capacitors (0603) TDK C1608C0G1E103J
C207	1	1000pF ±10%, 50V X7R ceramic capacitor (0805) Murata GCM216R71H102K
C208	1	0.022µF ±10%, 25V X7R ceramic capacitor (0402) TDK C1005X7R1E223K
C233	0	Not installed, ceramic capacitor (0603)
H1	1	72-pin (2 x 36) header
J1	1	High-speed automotive connector Rosenberger D4S20F-40MA5-Z

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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.

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
J2, J3, J23	0	Not installed, SMA connectors
J10	1	USB type-B right-angle female receptacle
J21	1	Phono jack
JU1–JU9, JU121, JU122, JU151, JU152	13	3-pin headers
JU10, JU21, JU22, JU23, JU125, JU153, JU154, JU191–JU194, JU210, JU261	13	2-pin headers
JU101–JU108, JU141–JU144, JU211–JU214	0	Not installed, 2-pin headers—short (PC trace)
L21, L22, L23, L101, L261	5	Ferrite beads (0603) TDK MMZ1608R301A
L262	1	3.3µH ±10% inductor (0805) Murata LQM21NN3R3K10
LED1, LED120, LED127, LED151–LED158	11	Red LEDs (0805)
LED2, LED126	2	Green LEDs (0805)
Q1, Q2	2	n-channel MOSFETs (SOT23) Central Semi 2N7002
R1, R2	2	45.3kΩ ±1% resistors (0603)
R3, R4	2	4.99kΩ ±1% resistors (0603)
R5, R11, R12, R111	4	2.2kΩ ±5% resistors (0603)
R13	1	0Ω ±5% resistor (0603)
R14, R15, R123, R126, R127, R151–R158, R203	14	1kΩ ±5% resistors (0603)
R101, R102	2	27Ω ±5% resistors (0603)
R103	1	1.5kΩ ±5% resistor (0603)
R104	1	470Ω ±5% resistor (0603)
R112, R122, R211, R212	4	10kΩ ±5% resistors (0603)
R121	1	1.1kΩ ±5% resistor (0603)
R191, R192, R201, R202	4	4.7kΩ ±5% resistors (0603)
R205	1	75kΩ ±5% resistor (0603)
R208	1	3.01kΩ ±1% resistor (0603)
R233	0	Not installed, resistor (0603)
SW1	1	Miniature SPDT toggle switch
SW122, SW150–SW157, SW221	10	Momentary pushbutton switches (6mm)
U1	1	GMSL serializer with HDCP (64 TQFP-EP) Maxim MAX9263GCB/V+
U2	1	1.8V, 500mA LDO regulator (8 µMAX®-EP) Maxim MAX1792EUA18+ (Top Mark: AAAA)
U10	1	UART-to-USB converter (32 TQFP)
U11	1	93C46-type 3-wire EEPROM 16-bit architecture (8 SO)
U12	1	Ultra-high-speed microcontroller (44 TQFP) Maxim DS89C450-ENL+
U13	1	Quad three-state buffer (14 SO) Fairchild 74AC125SC
U14	1	Level translator (14 TSSOP) Maxim MAX3378EEUD+
U15	1	I²C I/O expander (24 QSOP) Maxim MAX7324AEG+
U19	1	Dual bidirectional level translator (8 SOT23) Maxim MAX3373EEKA+ (Top Mark: AAKS)
U20	1	Digital audio receiver (28 TSSOP)
U21	1	16-bit dual-supply bus transceiver (48 TSSOP)
U22	1	Low-power dual-voltage µP supervisor (5 SC70) Maxim MAX6736XKTGD3+ (Top Mark: AFS)
U23, U24	2	2:1 noninverting multiplexers (6 SC70) Fairchild NC7SV157P6X_NL (Top Mark: VF7)

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
U25	1	Schmitt trigger buffer (5 SC70) Fairchild NC7SV17P5X_NL (Top Mark: V17)
U26	1	3.3V, 500mA LDO regulator (8 µMAX-EP) Maxim MAX1792EUA33+ (Top Mark: AAAC)
Y10	1	6MHz crystal (HCM49) Hong Kong X'tals SSL60000N1HK188F0-0

DESIGNATION	QTY	DESCRIPTION
Y12	1	14.7456MHz crystal (HCM49) Hong Kong X'tals SSM14745N1HK188F0-0
Y23	1	12MHz, 3.3V low-jitter oscillator (7mm x 5mm)
—	1	USB high-speed A-to-B cables, 6ft
—	24	Shunts
—	1	PCB: MAX9263 EVALUATION KIT

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Rosenberger Hochfrequenztechnik GmbH	011-49-86 84-18-0	www.rosenberger.de
TDK Corp.	847-803-6100	www.component.tdk.com

Note: *Indicate that you are using the MAX9263 when contacting these component suppliers.*

MAX9263 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX9263.EXE	Application program for both MAX9263 and MAX9264 devices
CDM20600.EXE	Installs the USB device driver
UNINSTALL.EXE	Uninstalls the EV kit software
USB_Driver_Help_200.PDF	USB driver installation help file

Quick Start

Required Equipment

- MAX9263 EV kit (USB cable included)
- MAX9264 EV kit (USB cable included)
- 2m Rosenberger cable assembly (included with the MAX9264 EV kit)
- Parallel data source (such as digital video)
- Optional: Function generator (needed only if parallel data lacks a pixel clock)
- Optional: Function generator (needed only if parallel data lacks a VSYNC)
- Optional: I²S or S/PDIF audio source
- Optional: Pair of 8Ω speakers
- Optional: 3.5mm stereo headphones (16Ω or greater)
- User-supplied Windows XP, Windows Vista, or Windows 7 PC with a spare USB port (direct 500mA connection required; do not use a hub)

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, 9263Rxx.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 Rosenberger cable from the MAX9263 EV kit J1 connector to the MAX9264 EV kit J1 connector.
5) Connect the parallel data source to MAX9263 header H1 (if using static data without a pixel clock, use external function generators to drive PCLK_IN and VSYNC).
6) *Optional Audio Demo*: Connect an S/PDIF audio source (such as DVD player digital output) to the MAX9263 EV kit J21 phono jack, or connect an I²S audio source to header H1 and remove jumper JU210. Connect speakers to the MAX9264 EV kit SPKR_L and SPKR_R oval pads, or plug headphones into the J206 headphone jack.
7) 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.
8) Verify that MAX9263 EV kit LED120 lights up, indicating that the microcontroller is powered and enabled.
9) Verify that MAX9264 EV kit LED120 lights up, indicating that the microcontroller is powered and enabled.
10) Verify that MAX9264 EV kit LED2 lights up, indicating that the link has been successfully established. If LED2 is off or LED1 is on, double-check that the PCLK_IN signal is clocking data.
11) *Optional Audio Demo*: If I²S or S/PDIF audio was provided to the MAX9263 EV kit, audio should now be heard from the speakers or headphones previously connected to the MAX9264 EV kit.
12) Start the MAX9263 EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software configuration window appears, as shown in Figure 8.
13) Press the **Connect** button and the configuration window disappears.
14) The EV kit software main window appears, as shown in Figure 1.
15) Press the **Read All** button to read all registers on MAX9263 and MAX9264.
16) *I²C Slave Device Demo:* Make sure that the MAX9264 EV kit jumpers JU151–JU154 are in the 1-2 position.
17) In the software's **MAX7324** tab sheet (Figure 4), press the **Search for MAX7324** button. Verify that the **MAX7324 Device Address** drop-down list shows **0xDA (JU151=1-2 JU152=1-2)**.
18) Press the **LED151-LED158 ON** button. Verify that MAX9264 EV kit LED151–LED158 turn on.
19) Press the **LEDs Alternating** button. Verify that MAX9264 EV kit LED151, LED153, LED156, and LED158 turn off.
20) *GPIO Demo:* In the software's **MAX9264** tab sheet (Figure 3), scroll down to **Register 0x06**. Uncheck **GPIO1OUT** and press **Write**. Verify that MAX9264 EV kit LED4 turns off.

21) Uncheck **GPIO0OUT** and press **Write**. Verify that MAX9264 EV kit LED3 turns off.

22) Check **GPIO1OUT** and press **Write**. Verify that MAX9264 EV kit LED4 turns on.

23) Check **GPIO0OUT** and press **Write**. Verify that MAX9264 EV kit LED3 turns on.

24) *INT Demo:* Toggle the MAX9264 EV kit switch SW2 up. Verify that MAX9263 EV kit LED1 turns on, indicating that the MAX9264 INT input is asserted.

25) In the software's **MAX9264** tab sheet, scroll to **Register 0x06** and press **Read**. Verify that **INT** is checked, indicating that the MAX9264 INT input is asserted.

26) Toggle the MAX9264 EV kit switch SW2 down. Verify that MAX9263 EV kit LED1 turns off, indicating that the MAX9264 INT input is not asserted.

27) In the software's **MAX9264** tab sheet, scroll to **Register 0x06** and press **Read**. Verify that **INT** is not checked, indicating that the MAX9264 INT input is not asserted.

28) *HDCP Authentication Demo:* Raise the **HDCP** tab sheet (Figure 7) and make sure that the **Link Check** drop-down list is set to **V00: No Link Check**.

29) Make sure the encryption button says **Enable Encryption** instead of **Disable Encryption**.

30) In **Register 0x95** Actrl, check or uncheck **EN_INT_COMP** to choose internal or external comparison mode. Refer to the MAX9263/MAX9264 IC data sheet for more information.

31) Press the **Authenticate** button. On success, the green LED (LED126) turns on; otherwise, the red LED (LED127) turns on.

32) Verify that the same R0 value is shown in **Register 0x85** on both the MAX9263 and the MAX9264.

33) *HDCP Encryption Demo:* Press the **Enable Encryption** button. The Ri keys are updated approximately every 2s, assuming that the VSYNC input rate is 60Hz. The GUI polls the Ri and Pj registers if their corresponding **Poll this register** checkbox is checked.

34) In the **Link Check** drop-down list, select **V80: Every 128 VSYNCs**.

35) The firmware performs the link integrity check after every 128 VSYNC pulses, turning off the green LED (LED126) if the link check fails.

36) In the **Link Check** drop-down list, select **V10: Every 16 VSYNCs**.

37) The firmware performs the advanced link integrity check after every 16 VSYNC pulses, turning off the green LED (LED126) if the link check fails.

Quick Start for Repeater Demonstration

Required Equipment

- 5V DC, 1000mA power supply
- Digital video source (or two function generators, to drive PCLK and VSYNC)
- Digital video display
- Two MAX9263 EV kit boards
- Two MAX9264 EV kit boards
- Two Rosenberger cables (included with the MAX9264 EV kit boards)
- Wires to interconnect the boards

Optional Equipment for Software Verification

- User-supplied Windows PC with available USB port
- USB A-to-B cable (included with the MAX9263 EV kit)

Procedure

1) Label the boards for reference. Refer to the *Example Repeater Network—Two µCs* section in the MAX9263/MAX9264 IC data sheet.
   - 1.1) Designate one of the MAX9263 EV kit boards as Board #1 TX_B1.
   - 1.2) Designate one of the MAX9264 EV kit boards as Board #2 RX_R1.
   - 1.3) Designate the other MAX9263 EV kit board as Board #3 TX_R1.
   - 1.4) Designate the other MAX9264 EV kit board as Board #4 RX_D1.

2) Prepare the bulkhead MAX9263 EV kit TX_B1.
   - 2.1) Update Board #1 TX_B1 firmware:
     - 2.1.1) **Start** | **Programs** | **Maxim EVKIT Software** | **MAX9263** | **Repeater Firmware** | **MAX9263EVKIT Bulkhead_UC_B Firmware Update**.
     - 2.1.2) The firmware update batch file instructs you to **Plug USB cable into Maxim Evaluation Kit to begin firmware update...** and **Press any key to continue...** After plugging in the USB cable, wait at least 5s to allow Windows to catch up. Press the Enter key to begin the firmware update. After approximately 1min, verify that the batch file reports **Exit code = 0 EXIT_CODE_SUCCESS**.
     - 2.1.3) *Diagnostic:* Windows reports **USB over current surge**. Check if the USB connector is the type that has a separate back shield that can short across the USB signal pins. Pry off this back shield cover to clear the short.

2.1.4) *Diagnostic:* **EXIT_CODE_JTAG_ABSENT**. The USB cable seems not to be connected, or possibly the USB device driver software not installed. Check setup using a known good unit. Verify that the 6MHz crystal is working. Visually inspect failed board FT232 chip connections.

2.1.5) Exit the firmware loader program.

2.1.6) Disconnect the USB cable from MAX9263 EV kit Board #1 TX_B1.

2.1.7) Replug the USB cable into the MAX9263 EV kit Board #1 TX_B1.

2.2 Configure Board #1 TX_B1 and UC_B (MAX9263 EV kit) as follows:

2.2.1) JU1 (CDS) = 2-3 to allow UC_B firmware to access the MAX9263 registers.

2.2.2) JU10 = 1-2 to power the UC_B microcontroller from the repeater-provided 5V power.

2.2.3) JU125 = 1-2 so UC_B can sense the VSYNC input.

3) Prepare the repeater board set MAX9264 EV kit RX_R1 plus MAX9263 EV kit TX_R1.

3.1) Update Board #2 RX_R1 firmware:

3.1.1) **Start** | **Programs** | **Maxim EVKIT Software** | **MAX9263** | **Repeater Firmware** | **MAX9264EVKIT Repeater_UC_R Firmware Update**.

3.1.2) The firmware update batch file instructs you to **Plug USB cable into Maxim Evaluation Kit to begin firmware update...** and **Press any key to continue...** After plugging in the USB cable, wait at least 5s to allow Windows to catch up. Press the Enter key to begin the firmware update. After approximately 1min, verify that the batch file reports **Exit code = 0 EXIT_CODE_SUCCESS**.

3.1.3) *Diagnostic:* Windows reports **USB over current surge**. Check if the USB connector is the type that has a separate back shield that can short across the USB signal pins. Pry off this back shield cover to clear the short.

3.1.4) *Diagnostic:* **EXIT_CODE_JTAG_ABSENT**. The USB cable seems not to be connected, or possibly USB device driver software not installed. Check setup using a known good unit. Verify that the 6MHz crystal is working. Visually inspect failed board FT232 chip connections.

3.1.5) Exit the firmware loader program.

3.1.6) Disconnect the USB cable from MAX9264 EV kit Board #2 RX_R1.

3.1.7) Replug the USB cable into the MAX9264 EV kit Board #2 RX_R1.

3.2) Modify Board #2 RX_R1 and UC_R (MAX9264 EV kit) as follows:

3.2.1) Install pins at JU141, JU142, GND, VIN, and IOVDD.

3.2.2) Make sure that RX_R1 JU143 and JU144 are open.

3.2.3) Connect a wire between RX_R1 JU143 bottom pin (U14 level-translated U12 RXD0) and TX_R1 JU141 top pin (MAX9263 TX).

3.2.4) Connect a wire between RX_R1 JU144 bottom pin (U14 level-translated U12 TXD0) and TX_R1 JU142 top pin (MAX9263 RX).

3.3) Modify Board #3 TX_R1 (MAX9263 EV kit) as follows:

3.3.1) Install pins at JU141, JU142, GND, VIN, and IOVDD.

3.4) Configure Board #2 RX_R1 and UC_R (MAX9264EVKIT) as follows:

3.4.1) JU8 ($\overline{\text{ENABLE}}$) = 2-3 so that $\overline{\text{ENABLE}}$ is low, driving the video outputs on header H1.

3.4.2) JU23 = open to disconnect IOVDD from the on-board 3.3V regulator U2.

3.4.3) JU1 (CDS) = 1-2 to allow UC_R firmware to access the MAX9264 registers.

3.5) Connect Board #2 to Board #3 as follows:

3.5.1) Connect Board #2 GND to Board #3 GND.

3.5.2) Connect Board #2 VIN to Board #3 VIN.

3.5.3) Connect Board #2 IOVDD to Board #3 IOVDD (powered by TX_R1 board's 1.8V regulator U2).

3.5.4) Connect RX_R1 header H1, pin 62 (PCLK) to TX_R1 header H1, pin 62 (PCLK).

3.5.5) Connect RX_R1 header H1, pin 40 (VSYNC) to TX_R1 header H1, pin 40 (VSYNC).

3.5.6) Connect RX_R1 header H1, pins 2–58 (D[0:28]) to TX_R1 header H1, pins 2–58 (D[0:28]).

3.6) Configure Board #3 TX_R1 (MAX9263 EV kit) as follows:

3.6.1) JU10 = open (board #3 TX_R1 microcontroller is not powered).

3.6.2) JU1 (CDS) = 2-3.

4) Connect the 5V power supply to Board #2 RX_R1 as follows (the USB does not provide sufficient current to power the EV kit demonstration):
   4.1) Set the 5V power-supply output voltage to 5V.
   4.2) Disable the power-supply output.
   4.3) Connect the power supply (+) to VIN.
   4.4) Connect the power supply (-) to GND.
5) *Optional:* Verify that the repeater passes power-on self-test without TX_B1 and RX_D1.
   5.1) Enable the 5V power supply.
   5.2) The Board #2 UC_R firmware verifies that required devices are attached and that required input signals are present. With no TX_B1 connection, the UC_R firmware should light LED127 and blink six red flashes on LED120 (to repeat the power-on test, press and release the reset button, SW122). If only four or five flashes on LED120, then RX_R1 is not connected correctly to TX_R1.
   5.3) Disable the 5V power supply after verifying UC_R reports the expected diagnostic code (six flashes).
6) Connect the authorized display MAX9264 EV kit RX_D1.
   6.1) Configure Board #4 RX_D1 (MAX9264 EV kit) as follows:
      6.1.1) JU1 (CDS) = 2-3.
      6.1.2) JU10 = open (board #4 RX_D1 microcontroller is not powered).
   6.2) Connect the digital video display to Board #4, header H1.
7) Connect the digital video source (or function generators) to Board #1 TX_B1 as follows:
   7.1) Connect video data D[0:28] to header H1, even-numbered pins 2–58.
   7.2) Connect the ground return to header H1, odd-numbered pins 1–71.
   7.3) Connect vertical sync VSYNC to H1, pin 40.
   7.4) Connect PCLK_IN to header H1, pin 62.
8) Connect a Rosenberger cable between Board #1 TX_B1 and Board #2 RX_R1 connector J1.
9) Connect a Rosenberger cable between Board #3 TX_R1 and Board #4 RX_D1 connector J1.
10) Set JU2 (BWS) and JU4 (DRS) for all four boards to the correct setting for the video signal PCLK frequency range. For example, if PCLK is between 8.33MHz and 16.7MHz, set JU2 (BWS) = 2-3 and JU4 (DRS) =1-2. Refer to the MAX9263/MAX9264 IC data sheet for more details.
11) Enable the 5V power supply. Verify that Board #2 LED3 and LED4 are on. Verify that Board #3 LED120 is on. Verify that Board #4 LED3 and LED4 are on. No LEDs on Board #1.
12) Enable PCLK. Verify that Board #2 LED3 and LED4 are on. Board #2 LED2 may or may not be visible due to the reduced IOVDD voltage (the LED2 circuit is designed for 3.3V, not 1.8V operation). Verify that Board #4 LED2, LED3, and LED4 are on.
13) Enable the video source (or function generator driving VSYNC).
14) The UC_R firmware performs a power-on self-test to verify that RX_R1 and TX_R1 are both accessible. The TX_B1-RX_R1 link is authenticated and then the TX_R1-RX_D1 link is authenticated. Encryption is enabled on both links. Finally, the KSV values are compiled and the SHA hash vector V is compared. The firmware reports success by lighting green LED126. If any part of the process fails, the firmware reports failure by lighting red LED127 while flashing diagnostic LED120. Table 2 lists the diagnostic LED codes for the repeater firmware (to repeat the power-on test, press and release the reset button, SW122).
15) *Optional:* Use the EV kit software to verify link authentication and encryption.
   15.1) 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.
   15.2) Start the MAX9263 EV kit software by opening its icon in the **Start | Programs** menu. The EV kit software configuration window appears, as shown in Figure 8.
   15.3) Press the **Connect** button and the configuration window disappears. The software resets the bulkhead firmware, which in turn resets the repeater firmware. Authentication success is indicated by green-light LED126, or failure is indicated by red-light LED127.
   15.4) The EV kit software main window appears, as shown in Figure 1. When using the repeater firmware, the EV kit software tries to read the registers while the repeater firmware is busy authenticating the display, so initially the Figure 1 window may show failed reads. *This is not an error.*
   15.5) Press the **Read All** button to read all registers on the MAX9263 (Board #1 TX_B1) and MAX9264 (Board #2 RX_R1).

15.6) On the **HDCP** tab sheet (Figure 7), verify that HDCP authentication between Board #1 and Board #2 is successful. The corresponding Bksv and Aksv values should match, and the Ri keys should be updated with the same value.

15.7) Verify that HDCP authentication between Board #3 and Board #4 is successful, by examining the KSV list (the software cannot directly access Board #3 or Board #4). The EV kit software does not have a KSV revocation list to search.

Detailed Description of Software

The main window of the evaluation software (Figure 1) shows a block diagram representing the MAX9263/MAX9264 system. The left column shows MAX9263 input data sources and the right column shows MAX9264 output data sinks.

The **Change Configuration** button brings up the software **Configuration** window (Figure 8), allowing the software GUI to select which side of the link the USB cable should be plugged into. Controlling from the MAX9264 side requires changing some jumper settings, as described in this window. If the MAX9263 and MAX9264 device addresses have been previously changed from their factory power-on-reset (POR) values, the new addresses must be specified in the software **Configuration** window to allow register access.

The **Baud Rate** drop-down list sets the communications baud rate. The USB link uses the same baud rate as the MAX9263/MAX9264. Note that the baud rate should only be changed one step at a time.

The **Read All** button reads all MAX9263 and MAX9264 device registers. The **Reset to Default Values** button restores the recommended factory settings and the **Write All** button writes all MAX9263 and MAX9264 device registers with the values shown in the GUI.

The **MAX9263** tab sheet (Figure 2) provides direct access to all MAX9263 registers, and the **MAX9264** tab sheet (Figure 3) provides direct access to all MAX9264 registers. Each register has its own **Read** and **Write** button. The small circle next to the **Read** button turns yellow to indicate an attempting read or write, red to indicate a failed read or write, or green to indicate a successful read or write operation.

The **MAX7324** tab sheet (Figure 4) controls the I²C I/O expander on the remote side of the link. When the USB is plugged into the MAX9263 EV kit, the **MAX7324** tab sheet controls the MAX7324 (U15) on the MAX9264 EV kit. Note that the MAX7324 actually has two device addresses, but for simplicity, the software GUI only displays the device address associated with the MAX7324 outputs. For details, refer to MAX7324 IC data sheet.

The **PRBS Test** tab sheet (Figure 5) uses the MAX9264 registers to perform a pseudorandom bit sequence (PRBS) error-rate test. Select the test duration (maximum 32767s = 9.1hrs) and press **Start**. The software GUI configures the MAX9264 to begin the PRBS test, counts down the specified delay time, and then reports the final value of the MAX9264 PRBSERR register.

The **Interface History and Low Level Access** tab sheet (Figure 6) shows the recent low-level communications activity between the software GUI and the MAX9263/MAX9264 devices. The **Register Access** group provides arbitrary device read/write control, supporting additional user-supplied devices besides the onboard MAX9263, MAX9264, and MAX7324. The **Device Address**, **Register**, and **Data** drop-down lists specify the device address and the register within the device, as well as one optional byte of data to be written. Pressing **Write Register** writes 1 byte of data to the specified device register. Pressing **Read Register** reads the specified device register and reports the result into the **Interface History** window. Devices that are not register-based (such as the MAX7324) are supported by **Send Data (no register)** and **Receive Data (no register)**. User-supplied devices requiring other interface protocols must use **Raw TX byte codes** to communicate. Note that in bypass mode, raw data is passed to the user-supplied slave device directly without modification.

The **HDCP** tab sheet (Figure 7) shows the HDCP registers of both the MAX9263 serializer and the MAX9264 deserializer side-by-side. This tab sheet is removed if the device capabilities register does not indicate that the device supports HDCP, so if the software is used with the MAX9259, MAX9260, MAX9249, or MAX9268, this tab sheet is not visible. Many of the HDCP registers are displayed as multiple hexadecimal bytes, with a 0x prefix before each byte and spaces between bytes. The **Authenticate** button commands the firmware to perform HDCP authentication, using either internal or external comparison depending on the **EN_INT_COMP** bit in the Actrl register. The **Enable Encryption** button waits for a falling edge on VSYNC and then writes to the MAX9263 Actrl and MAX9264 Bctrl registers, with the encryption enable bit set to 1. When the button caption changes to **Disable Encryption**, operation is the same except that the encryption enable bit is cleared to 0. After encryption is enabled, registers 0x85 and 0x87 are repeatedly polled as long as each register's **Poll this register** checkbox remains checked. The **Link Check** drop-down list configures the optional HDCP link integrity check, which can be used to check the R values every 128 VSYNC falling edges or check the P values every 16 VSYNC falling edges.

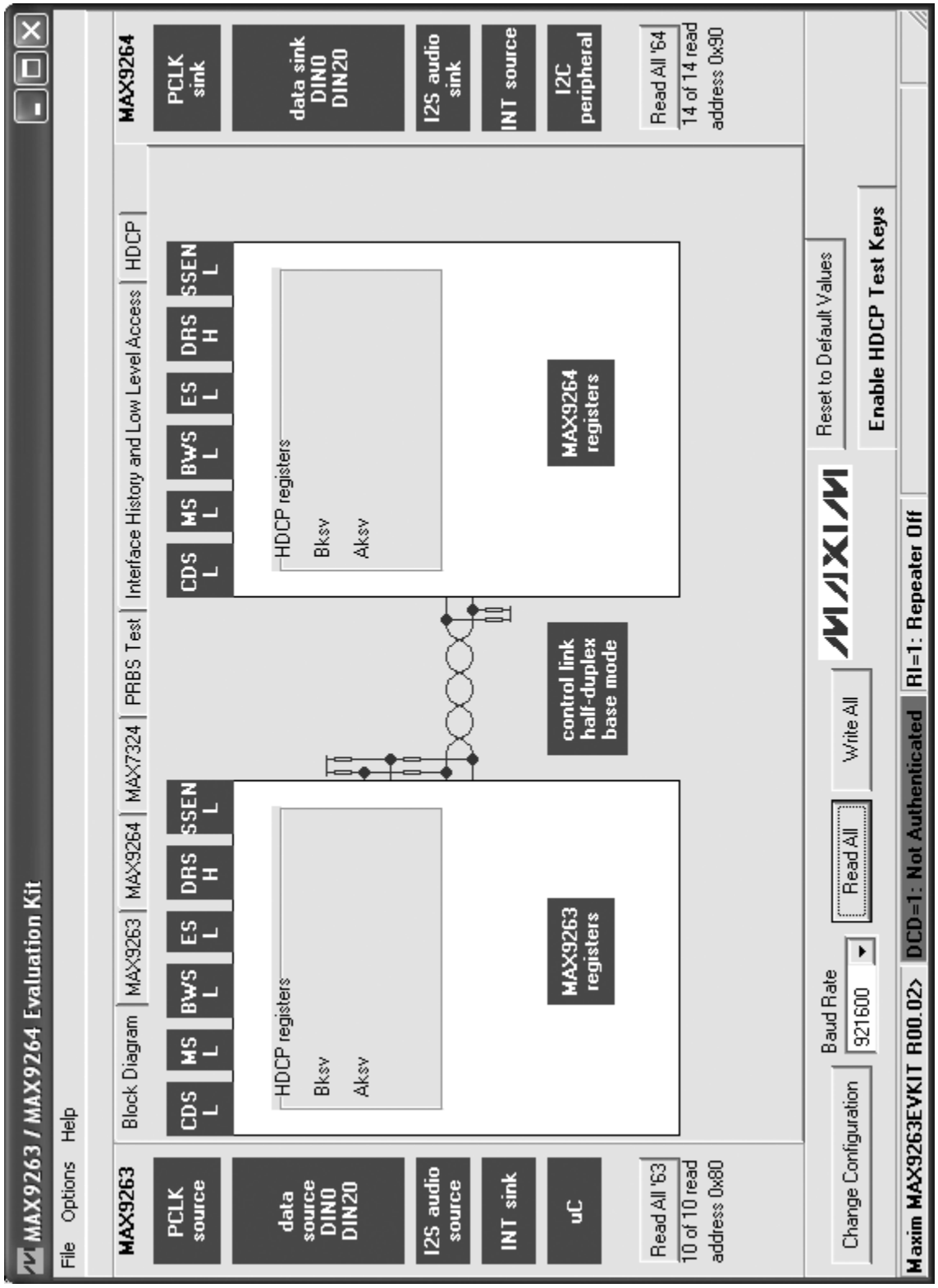

Figure 1. MAX9263/MAX9264 EV Kit Software Main Window (Block Diagram Tab)

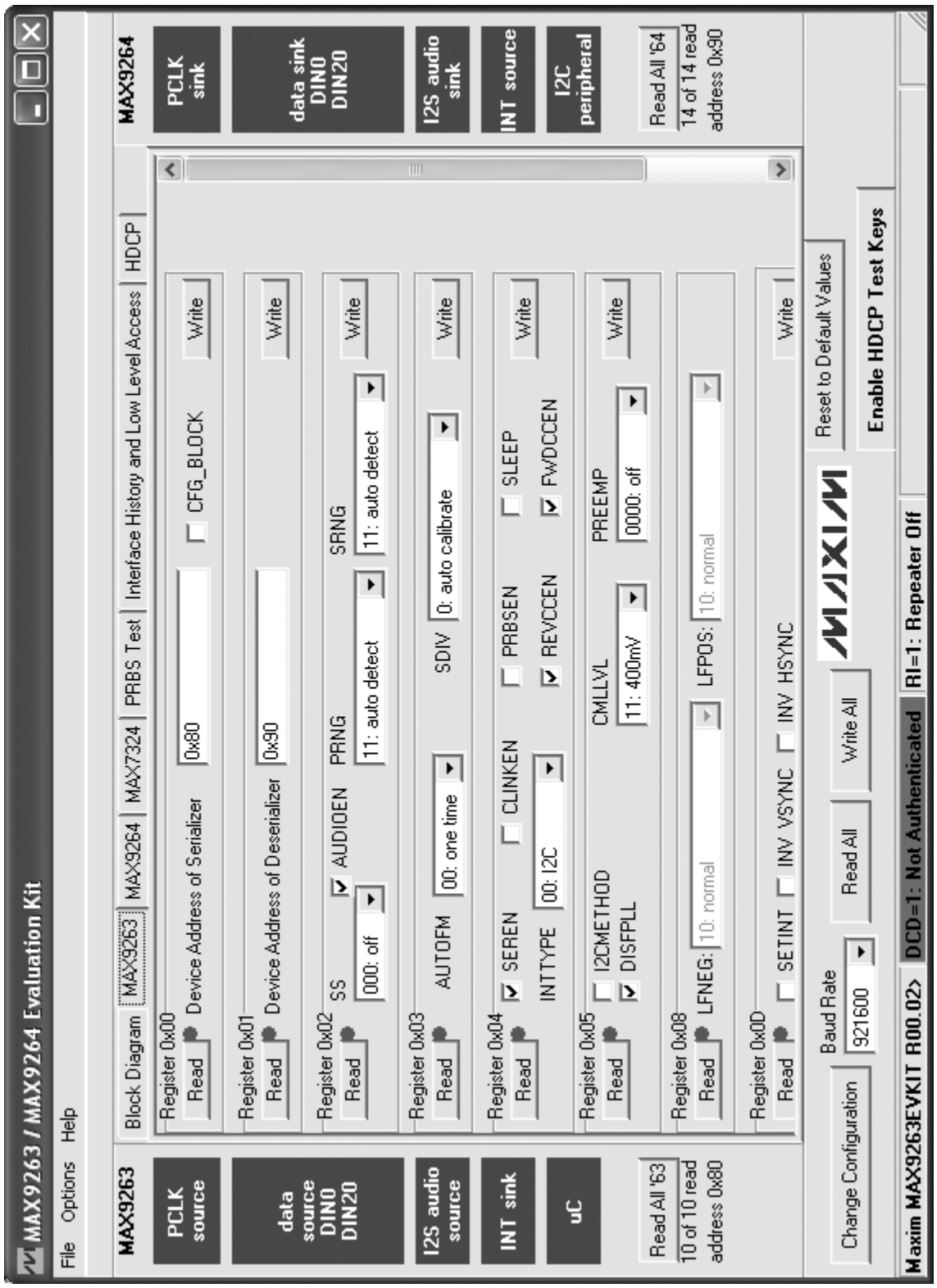

Figure 2. MAX9263/MAX9264 EV Kit Software Main Window (MAX9263 Tab)

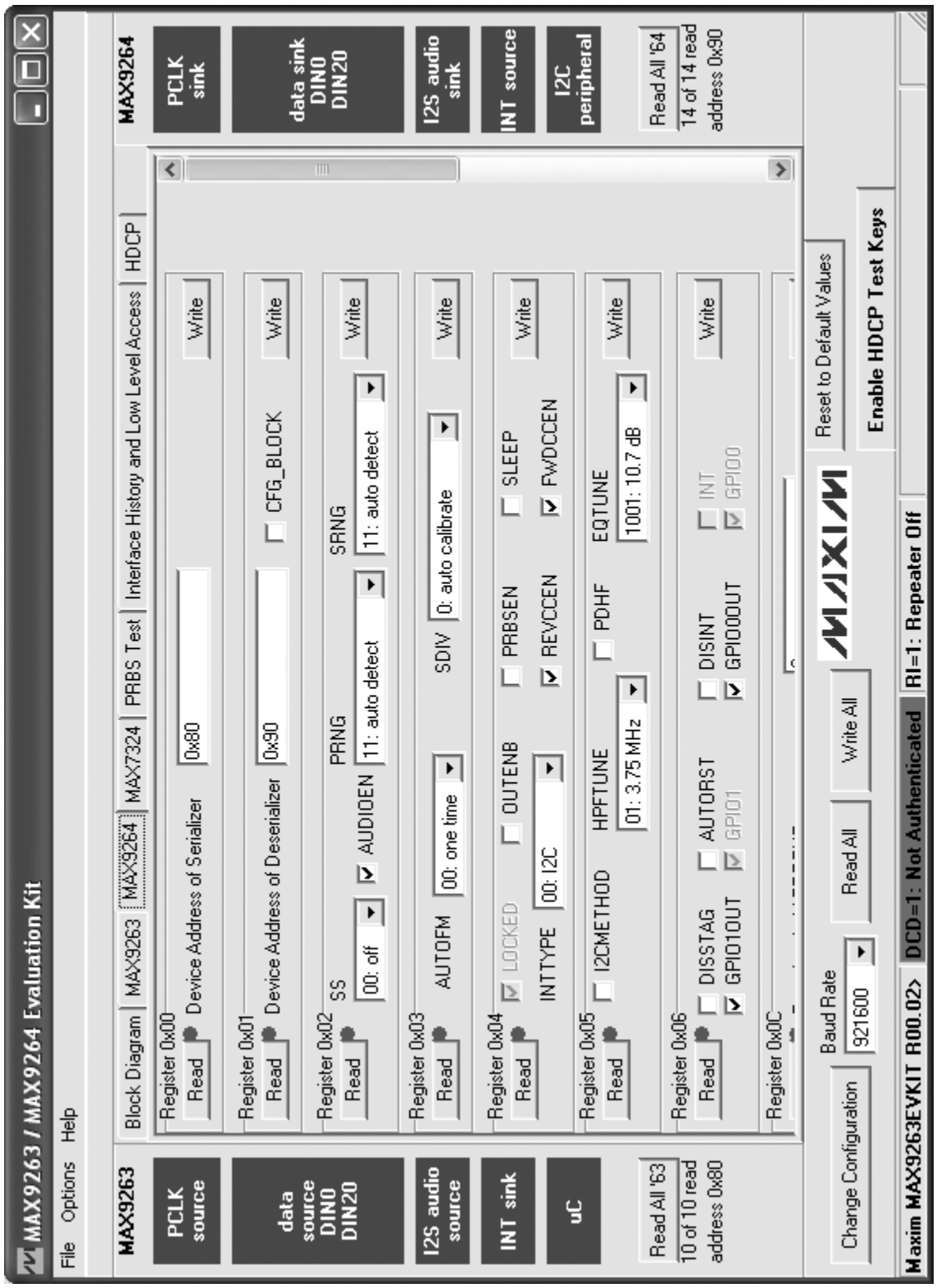

Figure 3. MAX9263/MAX9264 EV Kit Software Main Window (MAX9264 Tab)

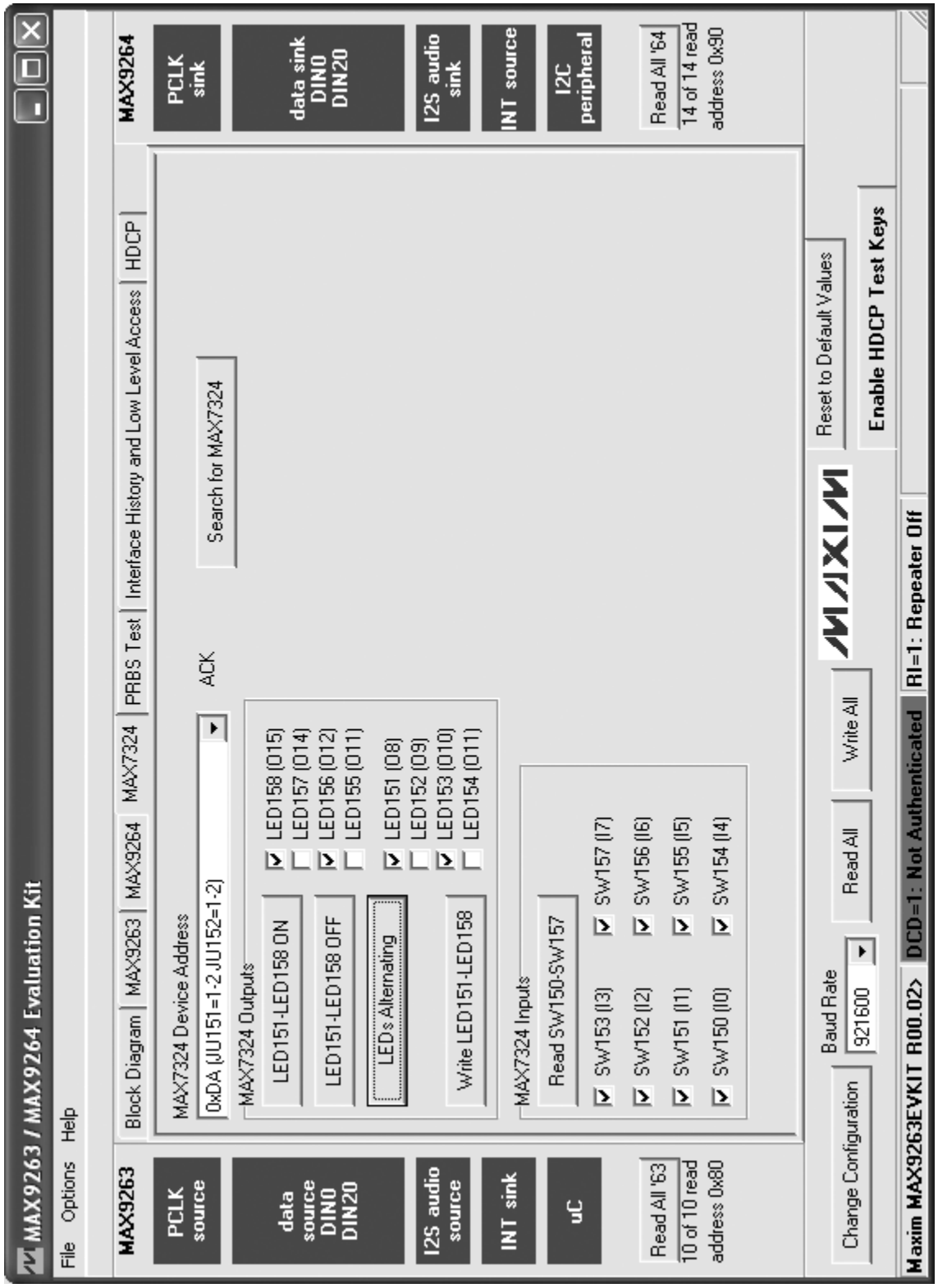

Figure 4. MAX9263/MAX9264 EV Kit Software Main Window (MAX7324 Tab)

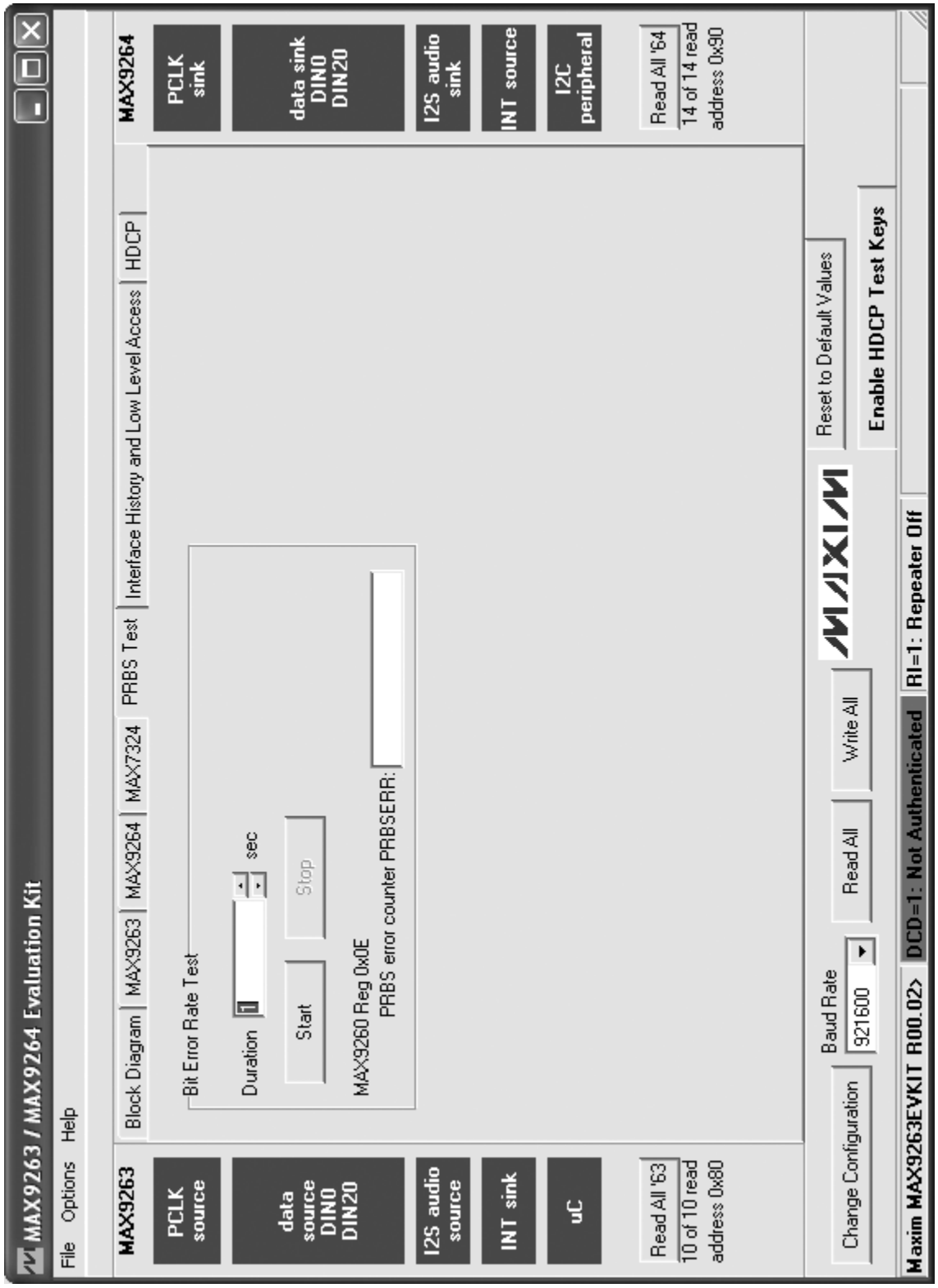

Figure 5. MAX9263/MAX9264 EV Kit Software Main Window (PRBS Test Tab)

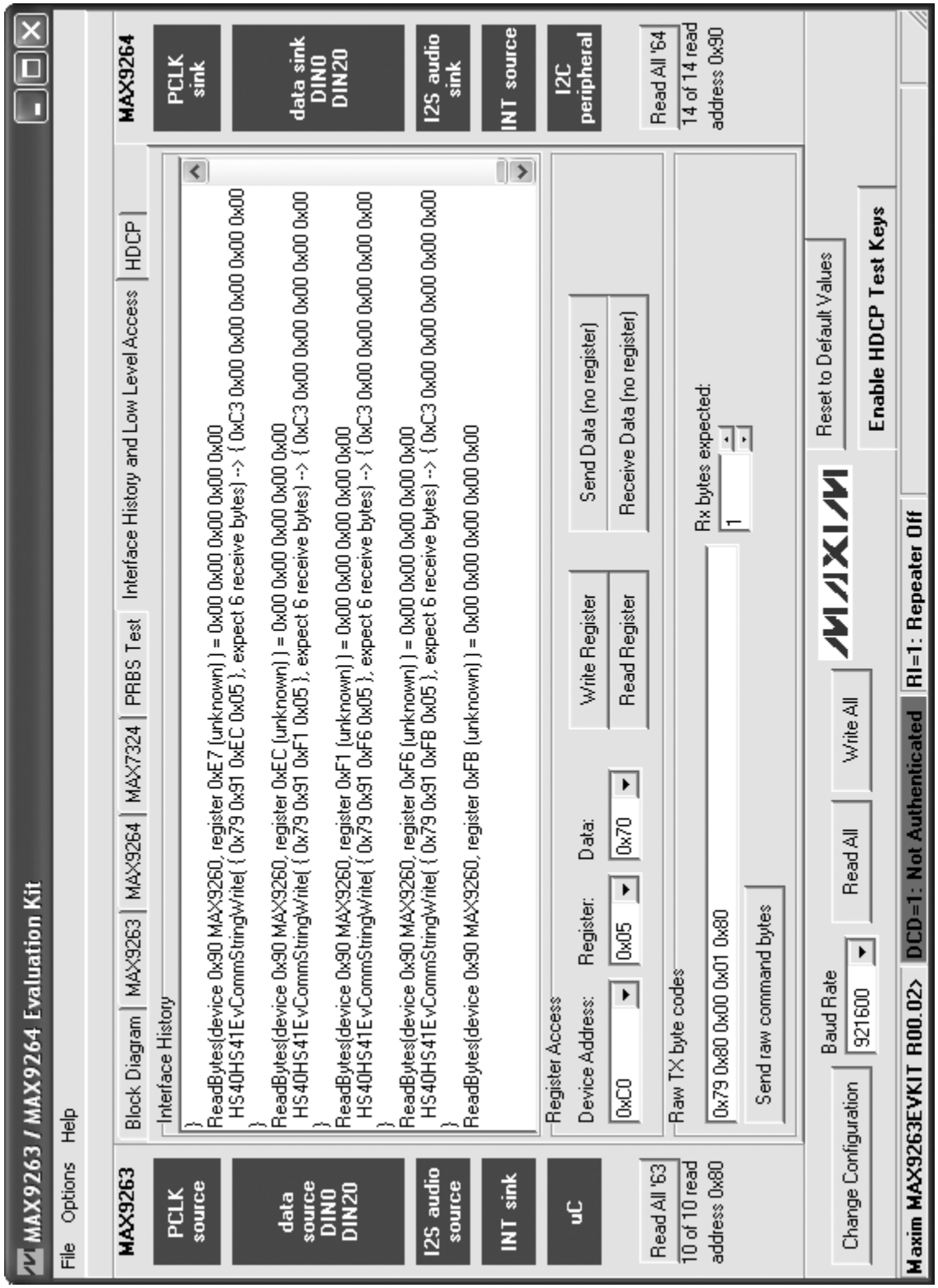

Figure 6. MAX9263 EV Kit Software Main Window (Interface History and Low Level Access Tab)

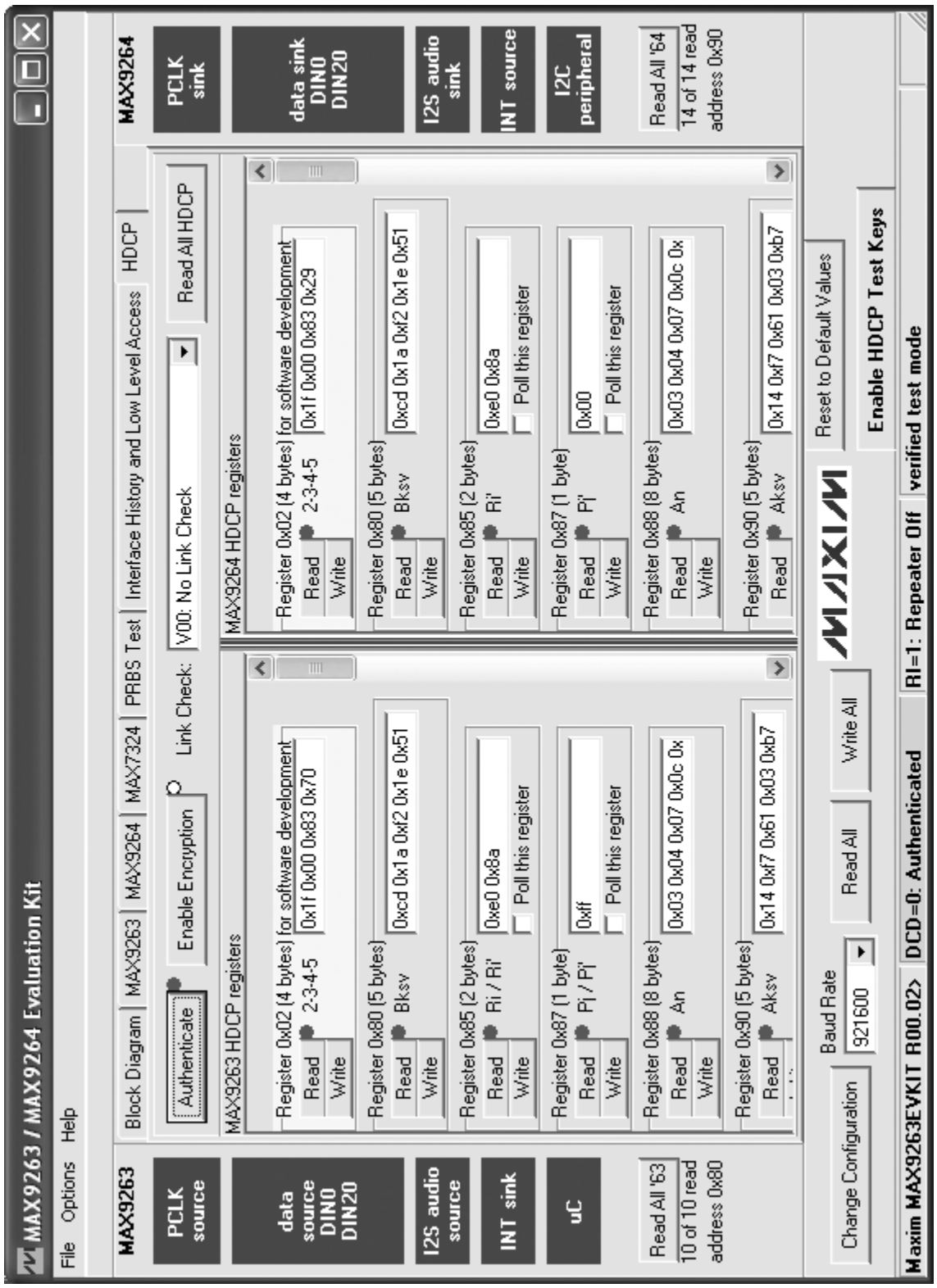

Figure 7. MAX9263/MAX9264 EV Kit Software Main Window (HDCP Tab)

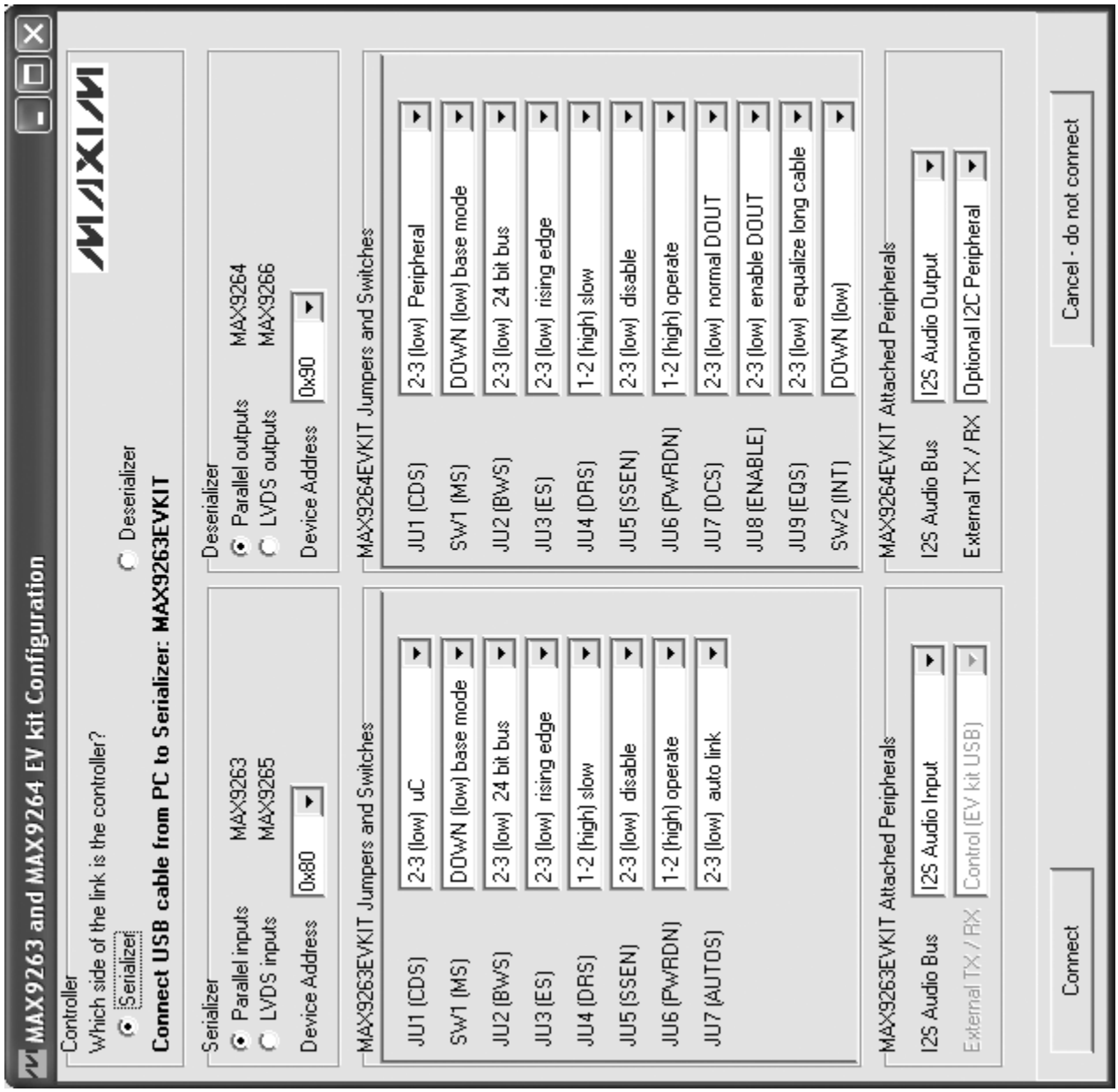

Figure 8. MAX9263/MAX9264 EV Kit Software Configuration Window

Detailed Description of Hardware

The MAX9263 EV kit provides a proven layout for the MAX9263 GMSL serializer with HDCP. On-board level translators, S/PDIF-to-I²S audio, and easy-to-use USB-PC connection are included on the EV kit.

The MAX9263 EV kit board layout is divided into four principal sections.

From header H1 to connector J1 are the support components specific to the MAX9263. On-board LDO regulator U2 powers the AVDD, DVDD, and IOVDD supplies from VIN. Jumper JU9 optionally connects VIN to the link cable, powering the remote EV kit board.

Below header H1, the board layout has three sections: microcontroller (U10–U14), I²C slave device (U15), and audio (U20–U25). The microcontroller and I²C slave device sections are identical on the MAX9263 and MAX9264 EV kits.

The audio section of the MAX9263 EV kit contains S/PDIF-to-I²S-audio-converter circuits (U20–U25), which can be disabled by JU210 for applications already having I²S audio.

The audio section of the MAX9264 EV kit contains I²S-to-audio DAC circuits (U20, U21) and a Class D stereo power amplifier (U25). The audio DAC circuit is similar to the MAX9850 EV kit, and the power amplifier (PA) circuit is similar to the MAX9701 EV kit.

User-Supplied Interface

To use the MAX9263 EV kit with a user-supplied interface, first cut the PCB traces at jumpers JU141 and JU142. Next, apply your own TX/SCL signal at the U1 side of JU141 and RX/SDA at the U1 side of JU142. Refer to the MAX9263/MAX9264 IC data sheet for details about UART protocol for base mode, write data format, read data format, selecting base mode or bypass mode, and selecting a UART or I²C slave device.

User-Supplied Power Supply

The MAX9263 and MAX9264 EV kits are powered completely from the USB port by default. The 5V USB bus power is supplied to the remote EV kit over the link cable by default. Jumper JU10 powers the link cable VBUS from the 5V USB supply, and jumper JU9 connects the link cable VBUS to the VIN power supply.

To provide external power to each EV kit's VIN, and still power both microcontrollers from the USB, remove the shunt from JU9 but leave the shunt at JU10 installed. The link cable carries the USB 5V bus power to the remote EV kit board, but external user-supplied VIN supplies are required to power the MAX9263 and the MAX9264.

To provide different power supplies to DVDD, AVDD, and IOVDD, remove the shunts from jumpers JU21, JU22, and JU23 and apply external user-supplied power at the DVDD, AVDD, and IOVDD oval pads.

The I²S audio link demonstration requires both MAX9263 EV kit and MAX9264 EV kit microcontrollers (U12) to be powered; otherwise, the on-board S/PDIF-to-I²S converter or the I²S audio DAC is not initialized.

Detailed Description of Firmware

The DS89C450 microcontroller (U12) runs custom firmware that ensures that no breaks occur within register read/write commands. The firmware records 9-bit even-parity data received from the USB interface while RTS is set, and plays back the 9-bit data with 1.5 stop bits timing when RTS is cleared. Data received from the MAX9263 is immediately relayed to the USB.

The audio chips are initialized by an I²C command sequence sent by the firmware when the microcontroller is reset. This initialization sequence covers both the S/PDIF-to-I²S converter and the MAX9850 I²S stereo audio DAC. Pressing SW122 resets the microcontroller, resending the audio I²C initialization commands.

The firmware also supports a small set of commands, available when RTS is clear. Since all register read/write requests are sent with RTS set, there is no conflict between register data and firmware commands. These firmware commands are issued automatically by the MAX9263 EV kit software GUI. The following information is provided for reference only:

- Firmware command "?" prints the firmware version banner message and brief command list.
- Firmware command "B" changes the baud rate by changing the internal TH1 baud-rate divisor. Refer to the firmware help command "?" for details. Pressing SW122 resets the USB baud rate to 921600 baud. The software GUI automatically sends the baud-rate change command.
- Firmware command "T" supports waking up the MAX9263 from the MAX9264 side of the link. Command "T" performs a dummy read, followed by a delay on the order of 1ms to 8ms, and finally writes a register value. For example, send "T810504800483" to read from device address 0x81 register 0x05, delay 4ms, then write to device address 0x80 register 0x04 data 0x83. This is the MAX9263 wake-up sequence for the default device addresses. The software GUI automatically sends this command when the **Wake Up MAX9263** button is pressed.
- Firmware commands "R" and "W" read and write device registers. The 8-bit device address, register address, length, and data are sent in hexadecimal. On success, the return code is "+" followed by the read data. On failure, the return code is "-".

- Firmware command “A” performs HDCP authentication. On success, the return code is “+”, LED126 (green) is on, and LED127 (red) is off. On failure, the return code is “-”, LED126 (green) is off, and LED127 (red) is on. Authorization status shown on the green LED is also available to the USB UART on the DCD modem-status signal.
- Firmware command “E” sets or clears the encryption enable bits, by waiting for VSYNC and then writing values to the MAX9263 Actrl and MAX9264 Bctrl registers.
- Firmware command “V” configures the VSYNC interrupt handler to enable the optional link integrity checks. “V80” enables the standard HDCP link authentication check after every 128 VSYNC falling edges. “V10” enables the advanced HDCP link authentication check after every 16 VSYNC falling edges. “V00” disables the interrupt service routine.
- Some commands are used only during firmware development. Firmware command “S” simulates a dummy device using on-chip memory instead of device registers, used during firmware development. Firmware command “~” prints a diagnostic trace dump used during firmware development. Firmware commands “1” and “2” perform HDCP link authentication check operations, used during firmware development. In normal operation, these operations are triggered by the VSYNC interrupt handler.

MAX9263/MAX9264 Repeater Demo (LED Error Codes)

The bulkhead firmware (UC_B) and repeater firmware (UC_R) both perform a self-test at power-up and after reset. The firmware first verifies that the required devices are attached and that the required input signals are present. If any of these required resources are not found, the firmware turns on LED127 (red, error/unauthenticated) and blinks an error code on LED120 (red, diagnostic code). If all required resources are found, and the links are successfully authenticated, then the firmware turns on LED126 (green, authenticated) steady on and blinks LED120 three times.

The repeater demo firmware only supports the minimal repeater configuration (DEPTH = 1, DEVICE_COUNT = 1). This is a limitation of the firmware and not a limitation of the MAX9263/MAX9264. DEPTH and DEVICE_COUNT values can be different for different repeater configurations.

The RX_R1 LED2 appears very dim, because the MAX9264 EV kit is designed to operate at IOVDD = 3.3V. However, in the repeater demo configuration, the MAX9264 IOVDD is powered from the MAX9263 EV kit board IOVDD, which is only 1.8V. Due to the lower interface supply voltage, green LED2 is very dim.

Table 1. MAX9263 EV Kit Jumper Descriptions

JUMPER	SIGNAL	SHUNT POSITION	DESCRIPTION
JU1	CDS	1-2	CDS = High. Optional peripheral attached to the MAX9263.
		2-3*	CDS = Low. ECU attached to MAX9263. **Connect the USB to the MAX9263 EV kit.**
		Open	Reserved.
JU2	BWS	1-2	BWS = High.
		2-3*	BWS = Low.
JU3	ES	1-2	ES = High.
		2-3*	ES = Low.
JU4	DRS	1-2*	DRS = High.
		2-3	DRS = Low.
JU5	SSEN	1-2	SSEN = High.
		2-3*	SSEN = Low.
JU6	$\overline{\text{PWDN}}$	1-2*	$\overline{\text{PWDN}}$ = High.
		2-3	$\overline{\text{PWDN}}$ = Low.
JU7	$\overline{\text{AUTOS}}$	1-2	$\overline{\text{AUTOS}}$ = High.
		2-3*	$\overline{\text{AUTOS}}$ = Low.
JU8	H1 odd pins	Open*	H1 odd-numbered pins connect to GND through R13.
		1-2	H1 odd-numbered pins connect to IOVDD. **R13 must be open.**
		2-3	H1 odd-numbered pins connect to GND.

Table 1. MAX9263 EV Kit Jumper Descriptions (continued)

JUMPER	SIGNAL	SHUNT POSITION	DESCRIPTION
JU9	Bus power	1-2*	J1 pin 1 connects to VIN.
		2-3	J1 pin 1 connects to GND.
		Open	J1 pin 1 unconnected.
JU10	Bus power	1-2*	J1 pin 1 connects to USB+5V.
		Open	USB power is not connected to link cable power.
JU21	AVDD	1-2*	AVDD power from 1.8V LDO U2, powered by VIN.
		Open	AVDD must be provided from an external source.
JU22	DVDD	1-2*	DVDD power from 1.8V LDO U2, powered by VIN.
		Open	DVDD must be provided from an external source.
JU23	IOVDD	1-2*	IOVDD power from 1.8V LDO U2, powered by VIN.
		Open	IOVDD must be provided from an external source.
JU101	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU102	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU103	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU104	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU105	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU106	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU107	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU108	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU121	Reserved	Not installed*	Reserved for factory diagnostic tests.
JU122	Reserved	Pin 1 only*	Reserved for factory diagnostic tests.
JU125	VSYNC	1-2*	Connects DIN19/VS to U12 interrupt input to allow firmware to count VSYNC edges when performing HDCP link check.
		Open	Disconnects DIN19/VS from U12 interrupt input.
JU141	TX/SCL	Not installed*	Connects U1 to U12 through level translator U14.
JU142	RX/SDA	Not installed*	Connects U1 to U12 through level translator U14.
JU143	LFLT	Not installed*	Connects U1 to USB through level translator U14.
JU144	INT	Not installed*	Connects U1 to USB through level translator U14.
JU151	U15 AD2	1-2*	Selects U15 I²C device address.
		2-3	Selects U15 I²C device address.
		Open	Reserved for factory diagnostic tests.
JU152	U15 AD0	1-2*	Selects U15 I²C device address.
		2-3	Selects U15 I²C device address.
		Open	Reserved for factory diagnostic tests.
JU153	U15 SDA	1-2*	Connects U15 MAX7324 to I²C bus. MS must be low (**SW1**) and CDS must be high (JU1 = 1-2 on both boards).
		Open	Disconnects U15 MAX7324 from I²C bus. MS can be high (**SW1**).
JU154	U15 SCL	1-2*	Connects U15 MAX7324 to I²C bus. MS must be low (**SW1**) and CDS must be high (JU1 = 1-2 on both boards).
		Open	Disconnects U15 MAX7324 from I²C bus. MS can be high (**SW1**).
JU191	AUDIO_SCL	1-2*	U12 sends I²C initialization commands to audio chip U20.
		Open	Disconnects audio I²C bus pullup resistor.
JU192	AUDIO_SDA	1-2*	U12 sends I²C initialization commands to audio chip U20.
		Open	Disconnects audio I²C bus.
JU193	AUDIO_SCL	1-2*	U12 sends I²C initialization commands to audio chip U20.
		Open	Disconnects audio I²C bus pullup resistor.

Table 1. MAX9263 EV Kit Jumper Descriptions (continued)

JUMPER	SIGNAL	SHUNT POSITION	DESCRIPTION
JU194	AUDIO_SDA	1-2*	U12 sends I²C initialization commands to audio chip U20.
		Open	Disconnects audio I²C bus.
JU210	U21 OE	1-2*	J21 S/PDIF input drives I²S audio to H1 and U1.
		Open	External user-supplied I²S can be connected to H1.
JU211	I²S WS	Not installed*	J21 S/PDIF input drives I²S audio to H1 and U1.
		Open	Disconnects I²S signals.
JU212	I²S SCK	Not installed*	J21 S/PDIF input drives I²S audio to H1 and U1.
		Open	Disconnects I²S signals.
JU213	I²S SD	Not installed*	J21 S/PDIF input drives I²S audio to H1 and U1.
		Open	Disconnects I²S signals.
JU214	I²S MCLK	Not installed*	J21 S/PDIF input drives I²S audio to H1 and U1.
		Open	Disconnects I²S master clock.
JU261	VMOD	1-2*	VMOD audio power from 3.3V LDO U26, powered by VIN.
		Open	VMOD audio power must be provided from an external 3.3V source.
SW1	MS	1-2 (toggle switch up)	MS = High. Full-duplex bypass mode. **Device registers not accessible.**
		2-3 (toggle switch down)	MS = Low. Half-duplex base mode. **Required when writing to device registers or when using external I²C peripheral.**

**Default position.*

Table 2. Diagnostic Error Codes from UC_B Bulkhead Firmware

LED120 FLASHES AFTER SELF-TEST	MEANING
3 green flashes on LED120, while steady on LED126 (green)	Success: Authenticated bulkhead link TX_B1 to RX_R1; authenticated display link TX_R1 to RX_D1; enabled encryption; exchanged Binfo and KSVlist.
4 red flashes on LED120	No PCLK IN signal received at TX_B1, or no RX_R1.
5 red flashes on LED120	No UC_R TXD0/RXD0 connection to TX_R1. Check the JU143, JU144 wires from the RX_R1 board to the TX_R1 board.
6 red flashes on LED120	No UC_B TXD1/RXD1 connection to TX_B1.
7 red flashes on LED120	No PCLK IN signal received at TX_B1, or no RX_D1 attached to TX_R1.
8 red flashes on LED120	No VSYNC IN to TX_B1.
9 red flashes on LED120	No UC_R connection to RX_R1.
10 red flashes on LED120	Bulkhead authentication failure between TX_B1 and RX_R1.
11 red flashes on LED120	Display authentication failure between TX_R1 and RX_D1.
12 red flashes on LED120	Encryption-enable failure.
13 red flashes on LED120	Error building KSV list.

Table 3. Diagnostic Error Codes from UC_R Repeater Firmware

LED120 FLASHES AFTER SELF-TEST	MEANING
3 green flashes on LED120, while steady on LED126 (green)	Success.
4 red flashes on LED120	No UC_R TXD1/RXD1 connection to RX_R1. Check if the RX_R1 board JU1 CDS shunt is in the 1-2 position.
5 red flashes on LED120	No UC_R TXD0/RXD0 connection to TX_R1. Check the JU143, JU144 wires from the RX_R1 board to the TX_R1 board.
6 red flashes on LED120	No PCLK IN signal received at TX_B1, or no TX_B1 attached to RX_R1.
7 red flashes on LED120	No PCLK IN signal received at TX_B1, or no RX_D1 attached to TX_R1.
8 red flashes on LED120	No VSYNC IN signal received at TX_B1.
11 red flashes on LED120	Display authentication failure between TX_R1 and RX_D1.
12 red flashes on LED120	Encryption-enable failure.
13 red flashes on LED120	Error building KSV list.

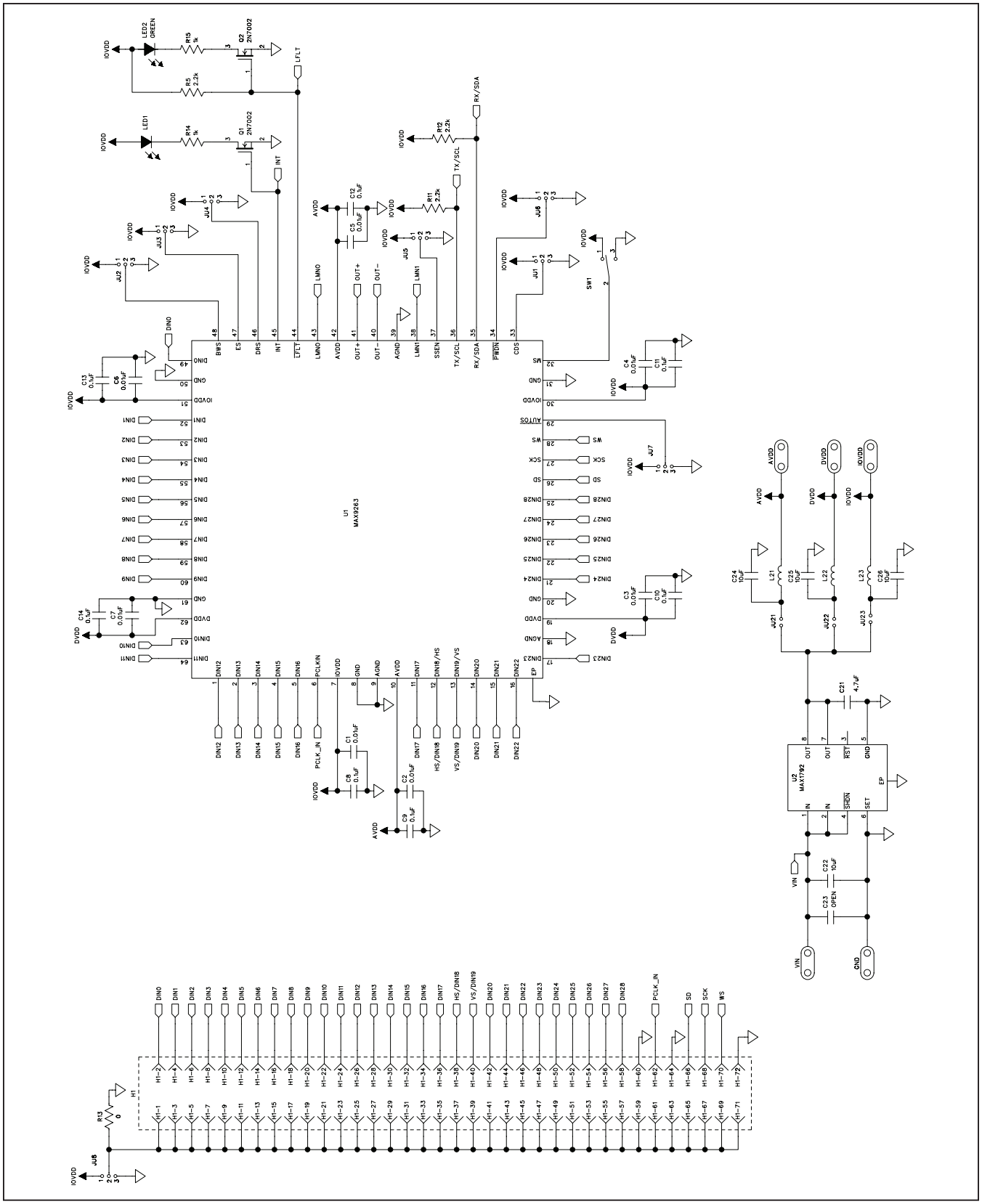

Figure 9a. MAX9263 EV Kit Schematic (Sheet 1 of 4)

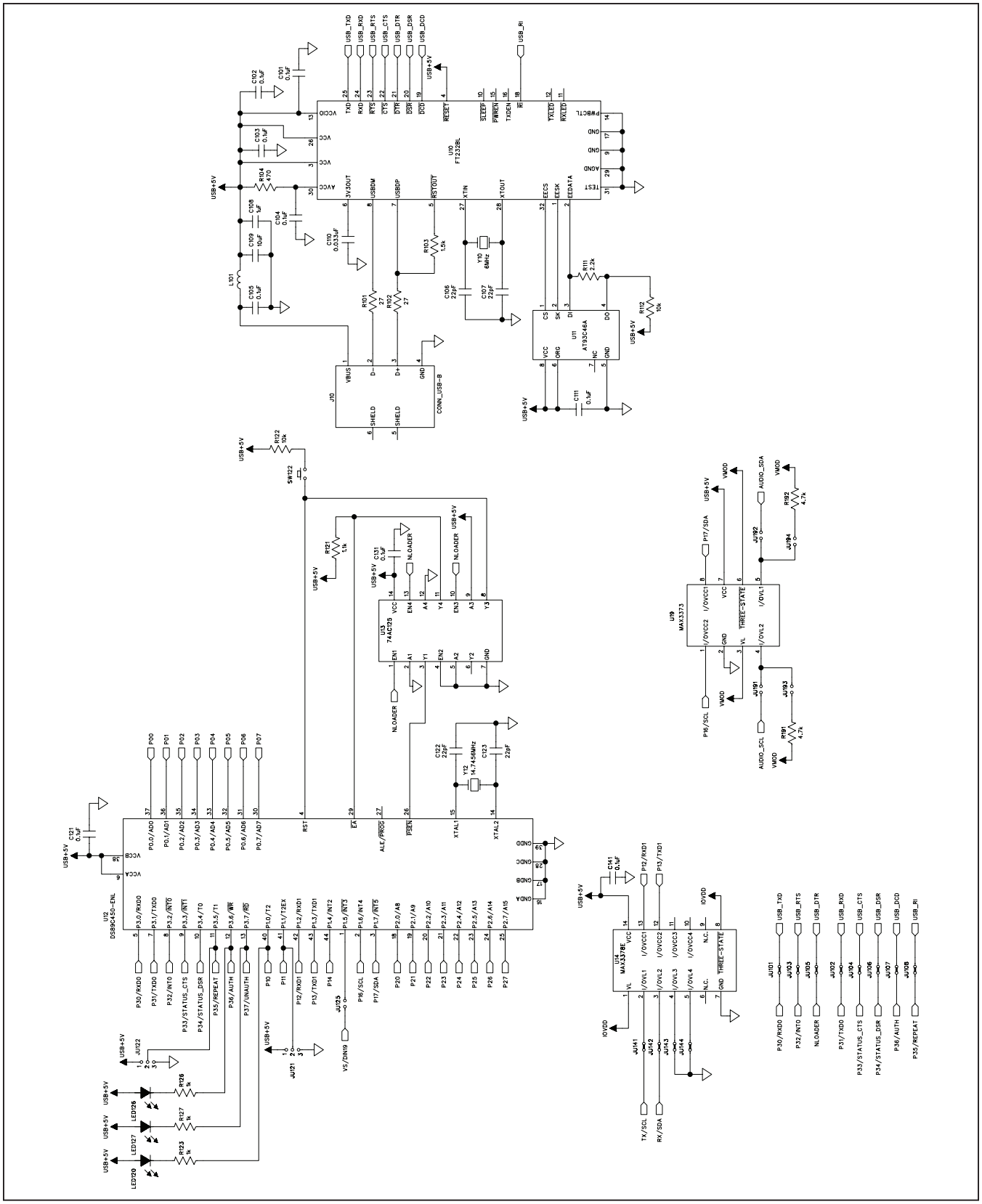

Figure 9b. MAX9263 EV Kit Schematic (Sheet 2 of 4)

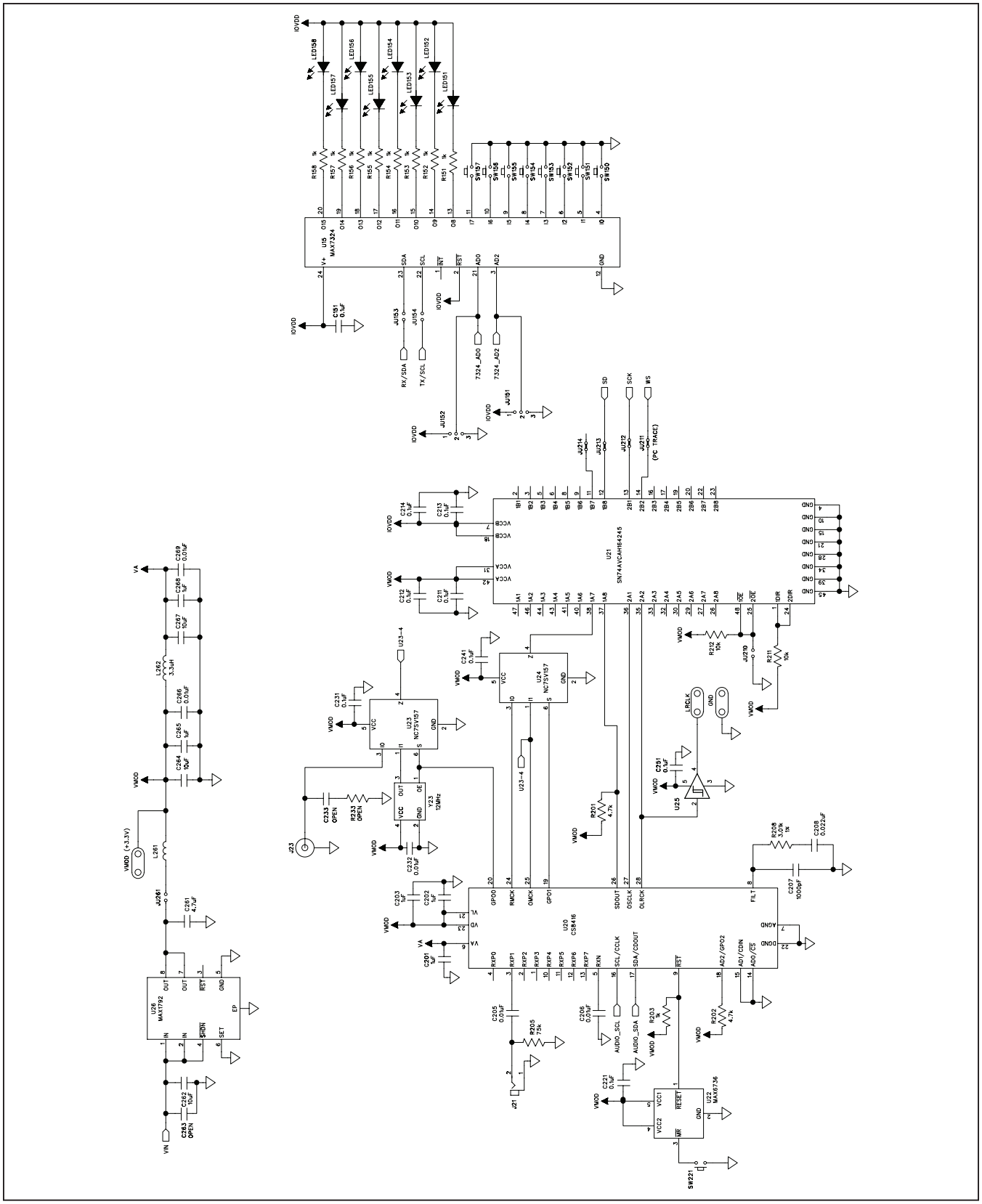

Figure 9c. MAX9263 EV Kit Schematic (Sheet 3 of 4)

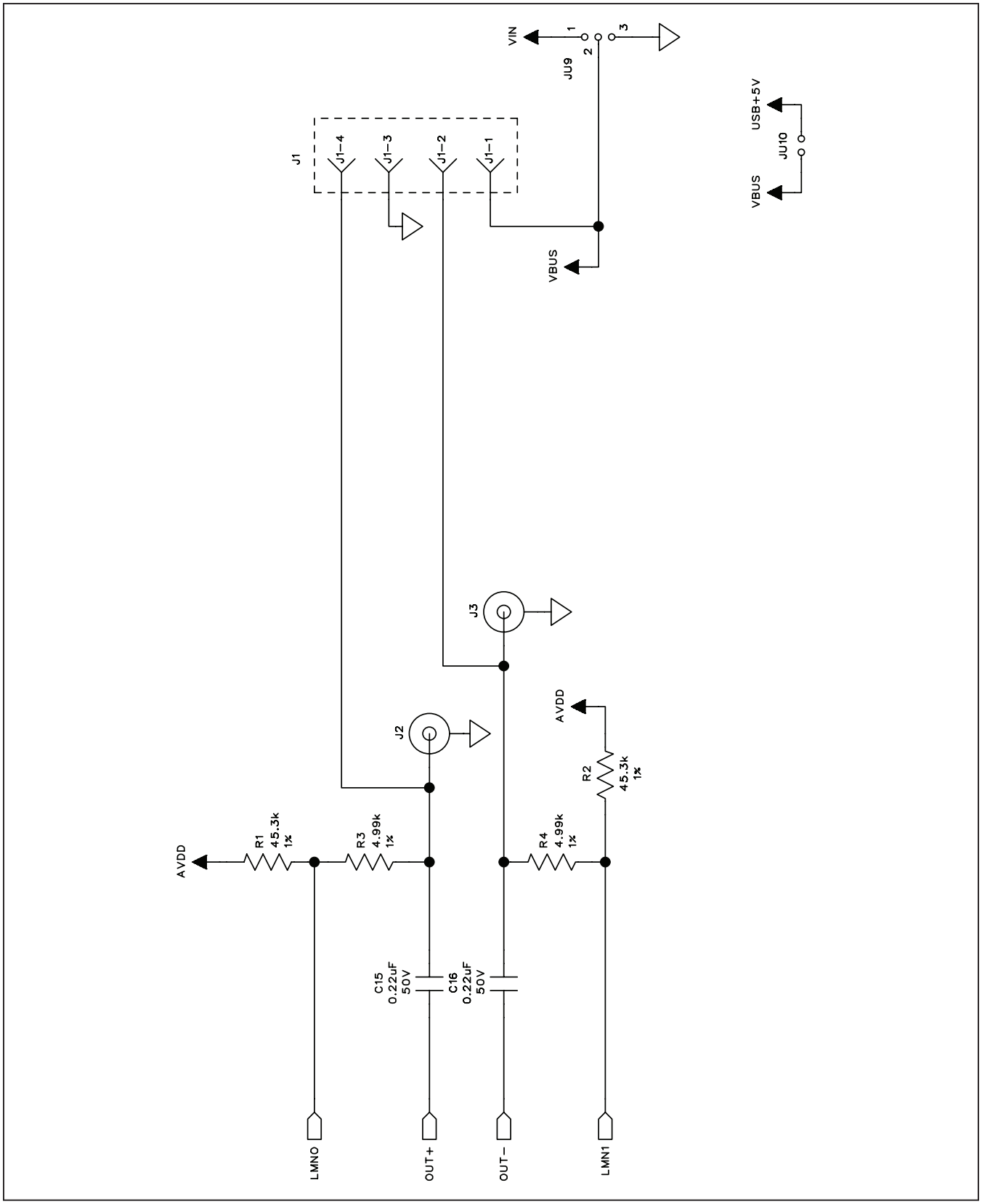

Figure 9d. MAX9263 EV Kit Schematic (Sheet 4 of 4)

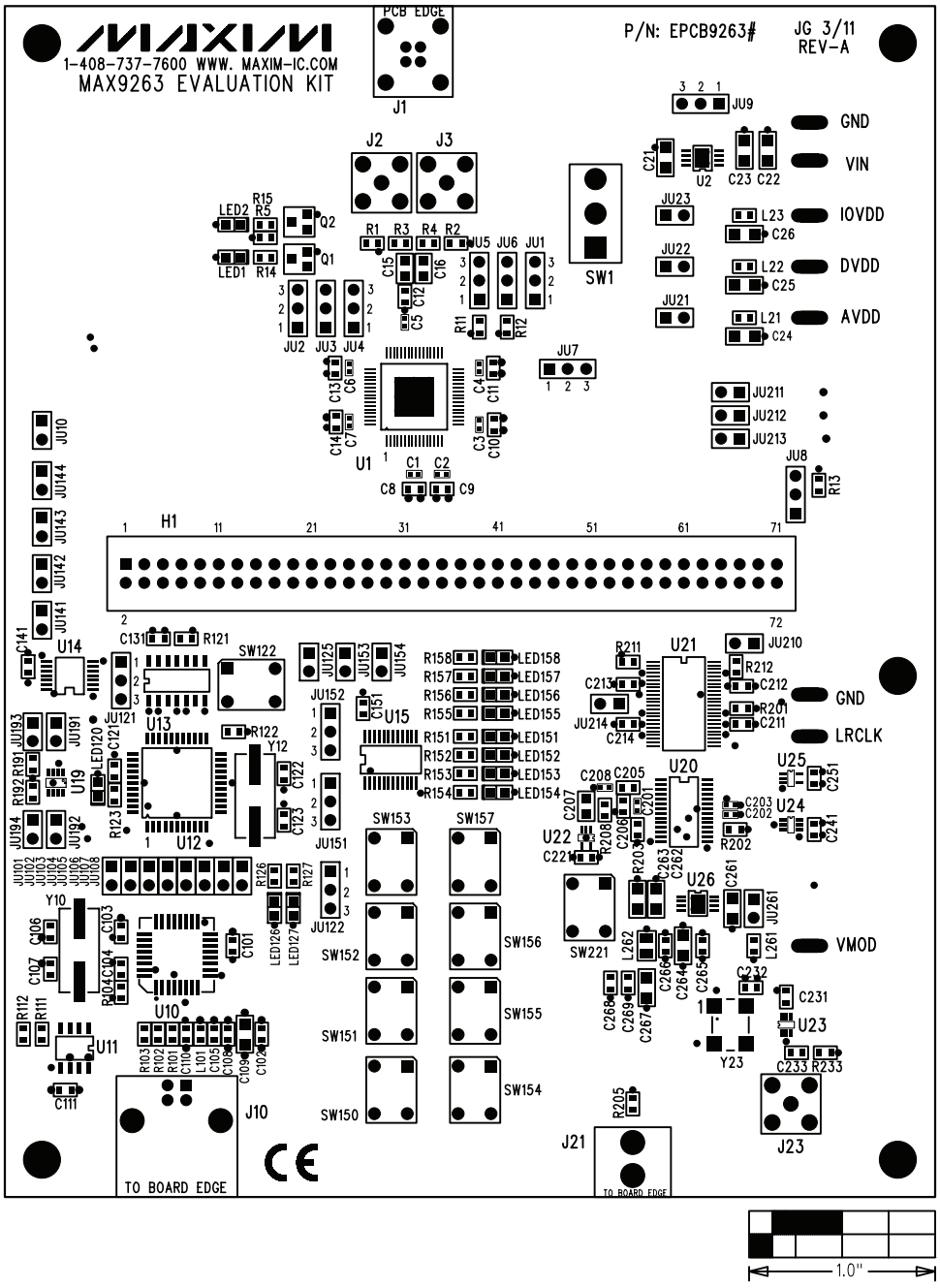

Figure 10. MAX9263 EV Kit Component Placement Guide—Component Side

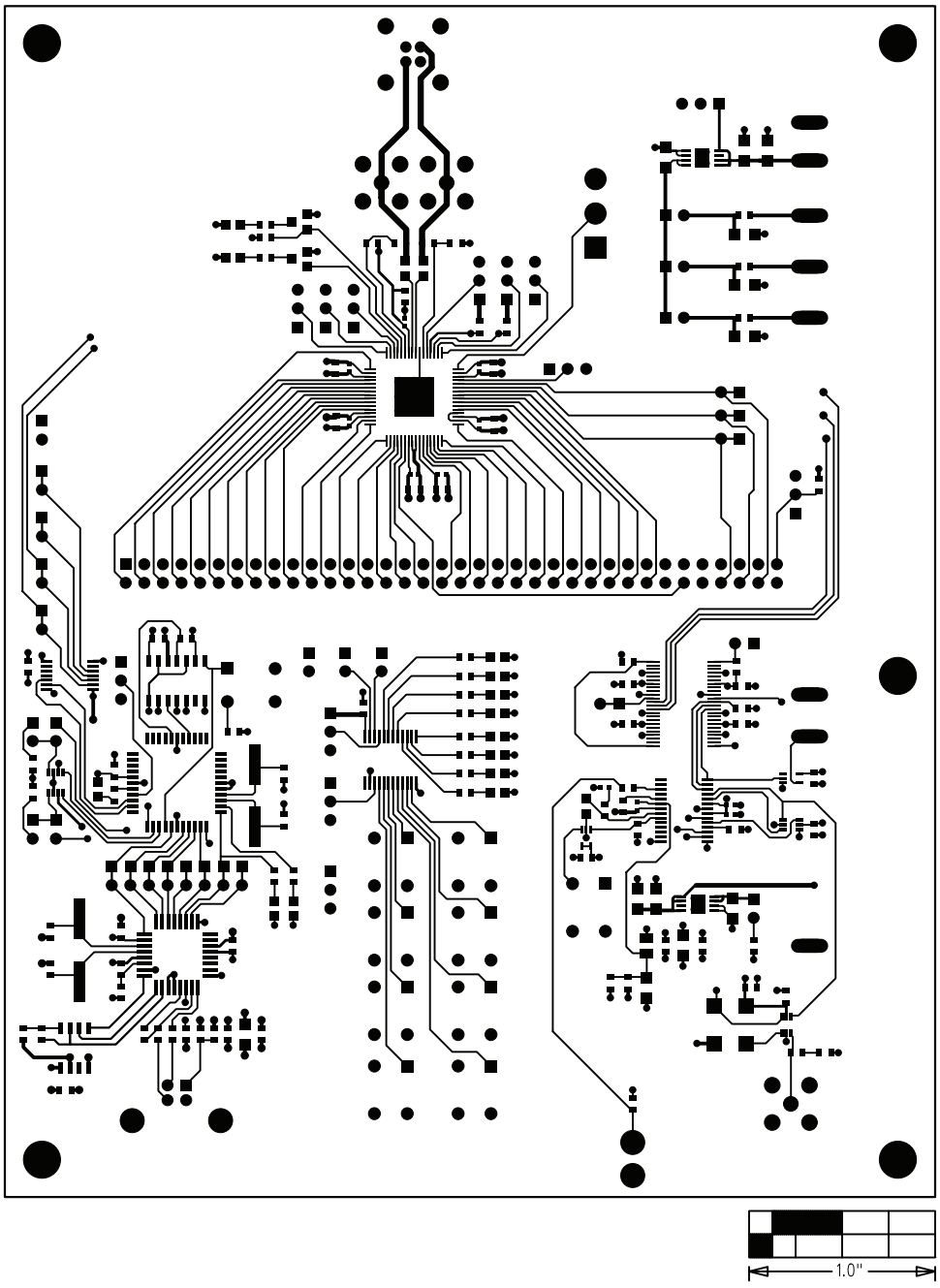

Figure 11. MAX9263 EV Kit PCB Layout—Component Side

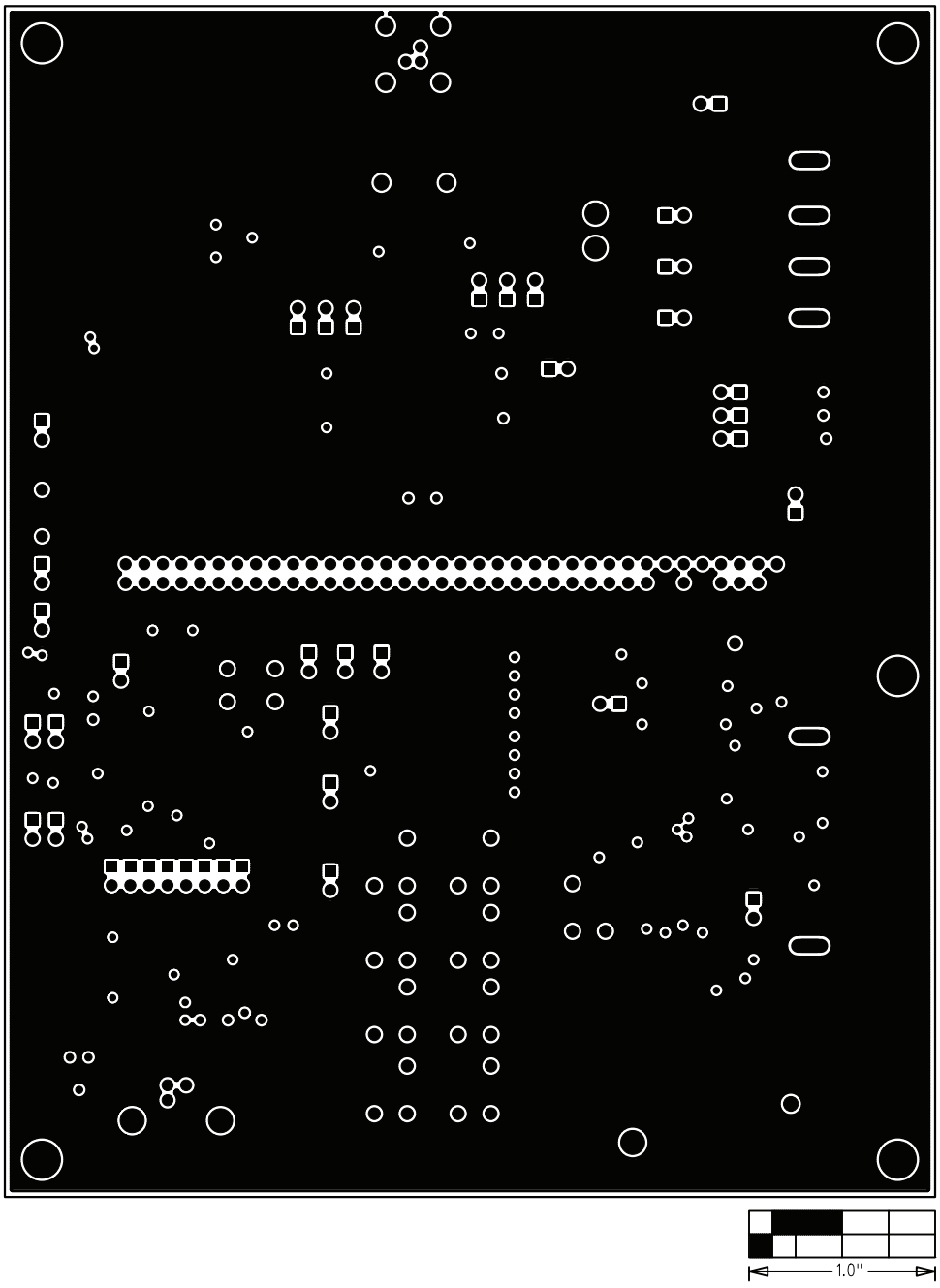

Figure 12. MAX9263 EV Kit PCB Layout—Ground Layer 2

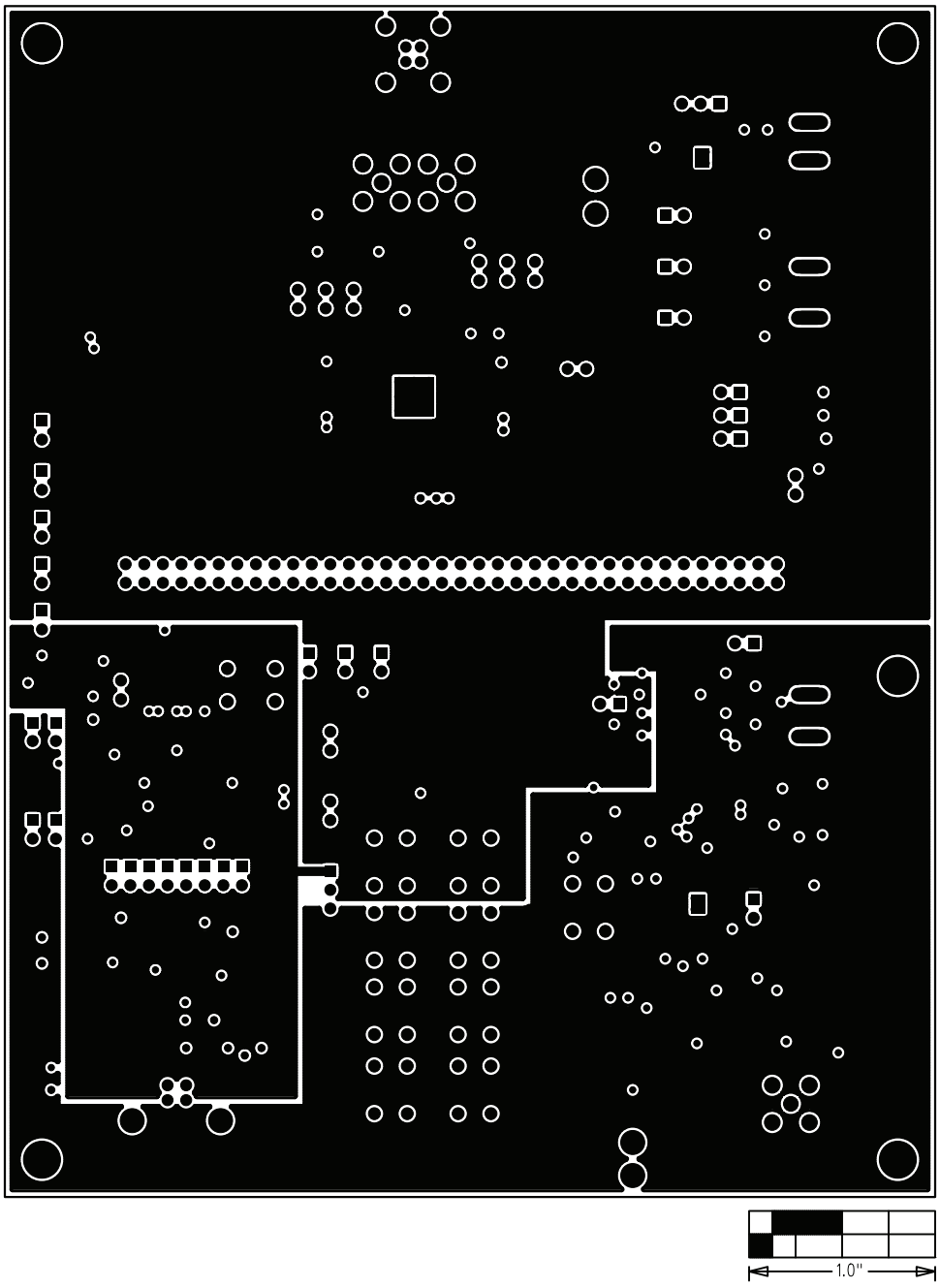

Figure 13. MAX9263 EV Kit PCB Layout—Power Layer 3

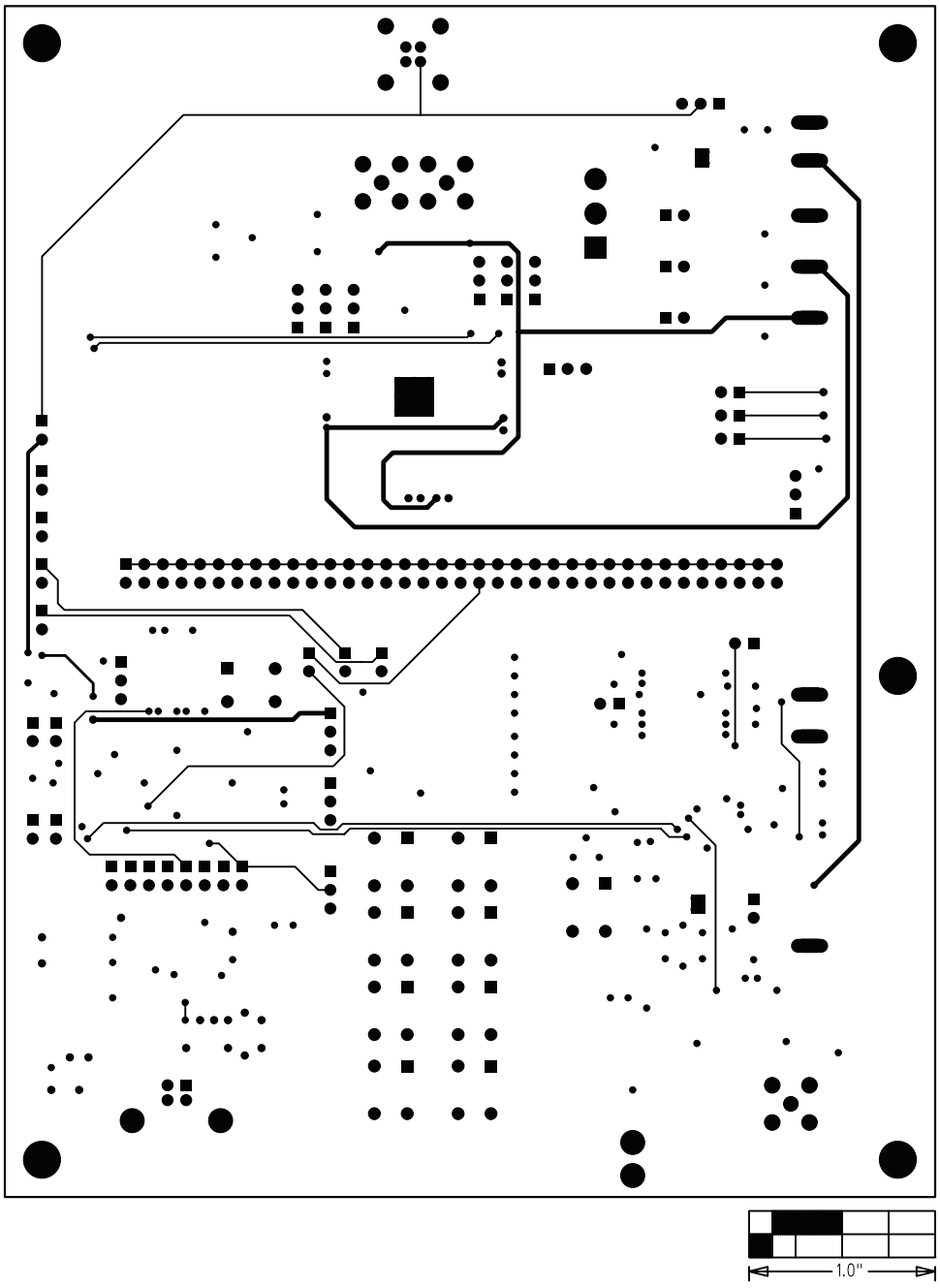

Figure 14. MAX9263 EV Kit PCB Layout—Solder Side

Ordering Information

PART	TYPE
MAX9263EVKIT#	EV Kit

#Denotes RoHS-compliant.

Note: *The MAX9263 EV kit should be ordered with its companion board, the MAX9264 EV kit.*

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	4/11	Initial release	—

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