MAX19791 Evaluation Kit

Evaluates: MAX19791

General Description

The MAX19791 evaluation kit (EV kit) simplifies the evaluation of the MAX19791. The MAX19791 dual general-purpose analog voltage variable attenuator (VVA) is designed to interface with 50Ω systems operating in the 50MHz to 4000MHz frequency range.

The MAX19791 is a monolithic VVA IC designed for Broadband System Applications, Including Wireless Infrastructure Digital and Spread-Spectrum Communication Systems WCDMA/LTE, TD-SCDMA/TD-LTE, WiMAX®, cdma2000M, GSM/EDGE, and MMDS Base Stations VSAT/Satellite Modems. The MAX19791 evaluation kit hosts a microcontroller (MCU) that uses a serial peripheral interface to configure internal registers and modes. The graphical user interface (GUI) software running on a computer makes it simple to program registers and control the device operation. The evaluation kit is fully assembled and tested at the factory.

This document provides a component list, a list of equipment required to evaluate the device, a straightforward test procedure to verify functionality, a description of the EV kit circuit, the circuit schematics, and artwork for each layer of the printed circuit board (PCB).

MAX19791 EV Kit Files

FILE	DESCRIPTION
Max19791_evkit_b_MARKETING_SCH	Schematic
MAX19791_EVKIT_B_MARKETING_PCB	Layout
marketing_bom_max19791_evkit_b	Bill of Materials

Features

- Easy Evaluation of the MAX19791 IC.
- On-Board DAC which Outputs 4V ±5% to Control the Attenuation.
- On-Board Power Supply +3.3V and +5V from MAX32625PICO.
- The Operating Frequency Range Extends from 50MHz to 4000MHz.
- 50Ω SMA Connectors on the RF Ports.
- All Critical Peripheral Components Included.
- A Micro USB Port for Interfacing with the PC.
- PC Control Software (available at **www.maximintegrated.com/evkitsoftware**).

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

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319-100634; Rev 0; 11/20

maxim integrated™

Quick Start

Required Equipment

This section lists the recommended test equipment to verify the operation of the MAX19791. It is intended as a guide only and some substitutions are possible.

- One RF signal generator capable of delivering minimum 0dBm up to 4.0GHz (Keysight N5182B or equivalent).
- An RF spectrum analyzer with a range of 100kHz to 4.0GHz (Keysight N9020A or equivalent).
- A dual power supply capable of supplying 3V to 5V up to at least 100mA.
- A digital multimeter for measuring the supply current (Keysight 34461A or equivalent) (optional).
- 50Ω coaxial RF cables with SMA connectors.
- A user-supplied Windows® 10 based PC.

Procedure

This section provides step by step procedure to operate the EV kit and test device functions. The EV kit is fully assembled and tested. Follow the instructions in the connections and setup section for proper device evaluation.

Caution: Do not turn on the DC power or RF signal generators until all connections are completed.

Detailed Description of Hardware and Software

The EV kit hosts a microcontroller platform MAX32625PICO, MAX5805 2-wire serial 12-bit DAC along with the MAX19791. The purpose of the microcontroller is to program the registers of the MAX19791 and the DAC. The DAC is used to generate the on-board analog attenuation control voltage.

Download the MAX19791 EV Kit Software

- Download the MAX19791 EV kit software from the **link**, run the installation file, and install it.
- Run the MAX19791 EV kit software through the desktop icon to open the GUI.

Note that the GUI runs only on Windows 10 PCs.

Powering and Connecting the EV Kit

- Verify that all jumpers are in place. Pins 2-3 of header J10 should be shorted. Pins 1-2 of J8, J4 shorts if one wants to use the on-board DAC to control the RF attenuation.
- With its output disabled, connect a 5V power supply to the TP8 and TP7 test points through an ammeter (apply +5V power supply to the VCC (TP8) and GND (TP7) test points). If available, set the current limit to 50mA. Account for the IR voltage drop through the ammeter and adjust the power supply to get 5V at the EV kit power supply test pins.
- If using an external power supply to provide the RF attenuation control voltage, remove jumper (if connected) from J8 and apply external control voltage at pin-2 of J8. Set the gain control voltage to 4V, but leave the control supply powered off for now. See Figure 1.
- Connect the MAX19791 EV kit to the PC running the GUI through the USB cable and power on the EV kit. A green LED on the MCU module blinks green approximately once per second.
- Open the Digital VVA GUI.exe software. Click on the **Device** tab and select the MAX19791 from the drop-down box. See Figure 2. Click the **Scan** button in the **COM Adapter** section and select the appropriate COM port from the drop-down box. Click the **Connect** button. The **Connected** message appears on the right bottom of the GUI. See Figure 3.
- In the **Configuration** panel, select the **V_{CC} Voltage** and reference for **Internal** and **External DAC**.
- Enable the power supply (5V) and control supply (1V).
- The supply current from the 5V, VCC supply reads approximately 19mA. The device current is 13mA and the LEDs consume 6mA.
- With its output disabled, set the RF signal generator to a 900MHz frequency at 0dBm.
- Connect the output of the RF signal generator to the SMA connector labeled RF IN1 on the EV kit.

Windows is a registered trademark and registered service mark of Microsoft Corporation.

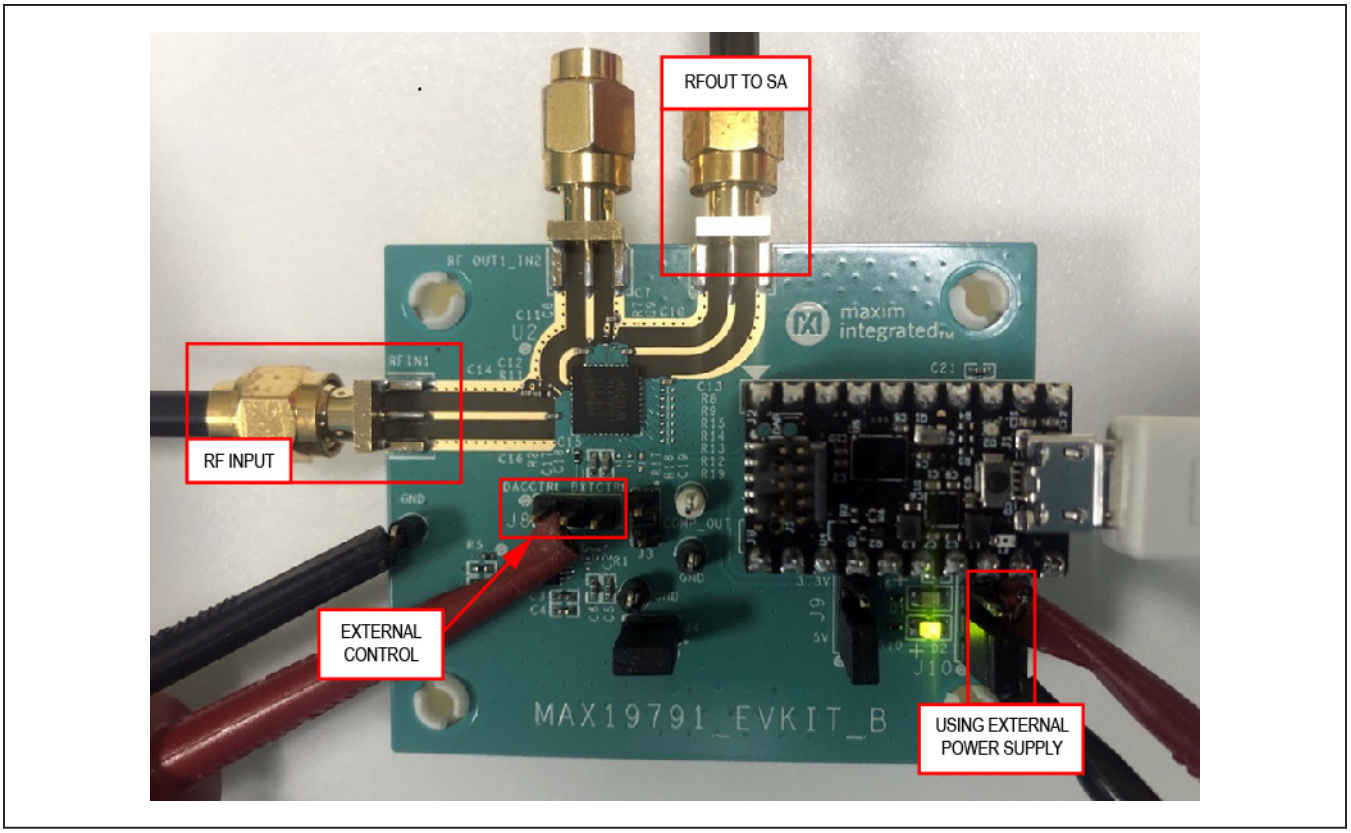


Figure 1. Connection Setup for Using External Power Supply and External Control Voltage

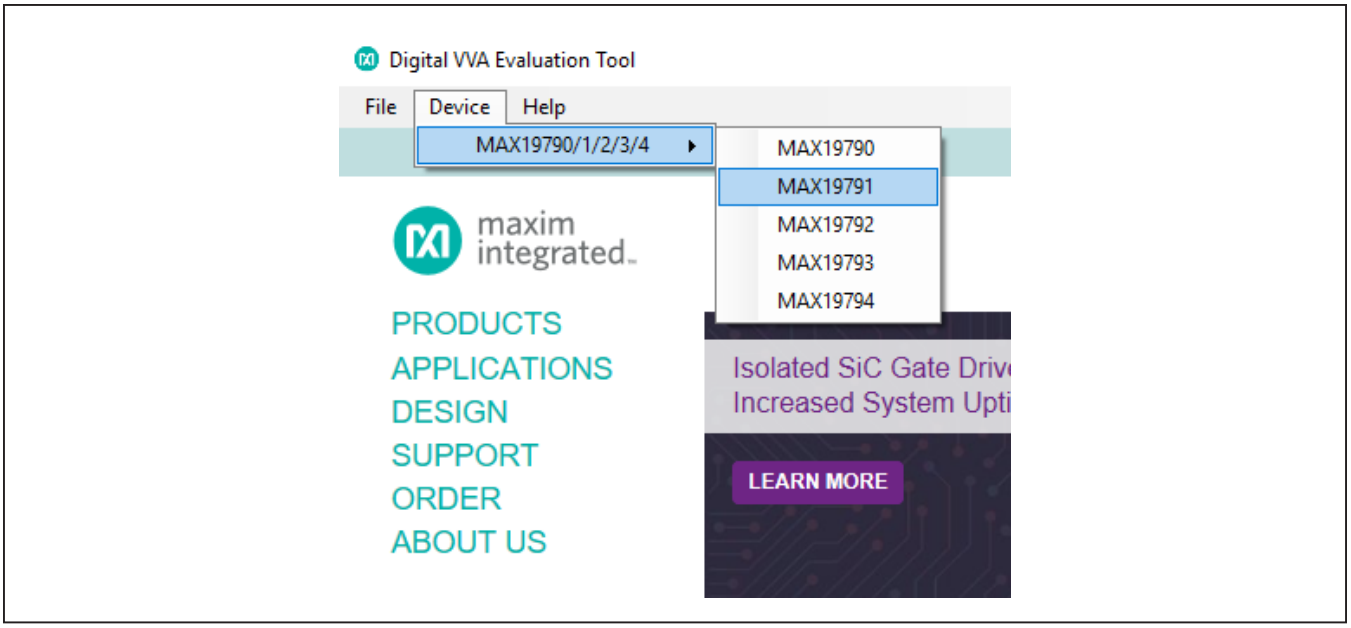


Figure 2. Part Selection in Common GUI

- Connect one output RF OUT2 to a spectrum analyzer.
- Terminate the unused ports with a 50Ω SMA terminator.
- Enable the output of the RF signal generator.
- Observe the output at 900MHz with a tone power of about -50dBm on the spectrum analyzer.

Note 1: Remove diodes D1 and D2 for device current measurement.

Note 2: The RF attenuation control voltage can be set either by an external power supply or by using a DAC on the EV kit. If the on-board DAC is selected, then set the voltage through the CTRL pin input widget. Simply type in the desired voltage between 1V and 4V (based on the operating VCC) and hit **Enter**. It is a good idea to probe the actual control voltage with a multimeter and make small adjustments to the programmed voltage to compensate for any offsets that can exist. Use the on-board power supply by choosing a 3.3V or 5V using J9, and shorting pins 1-2 pins of J10. See Figure 4.

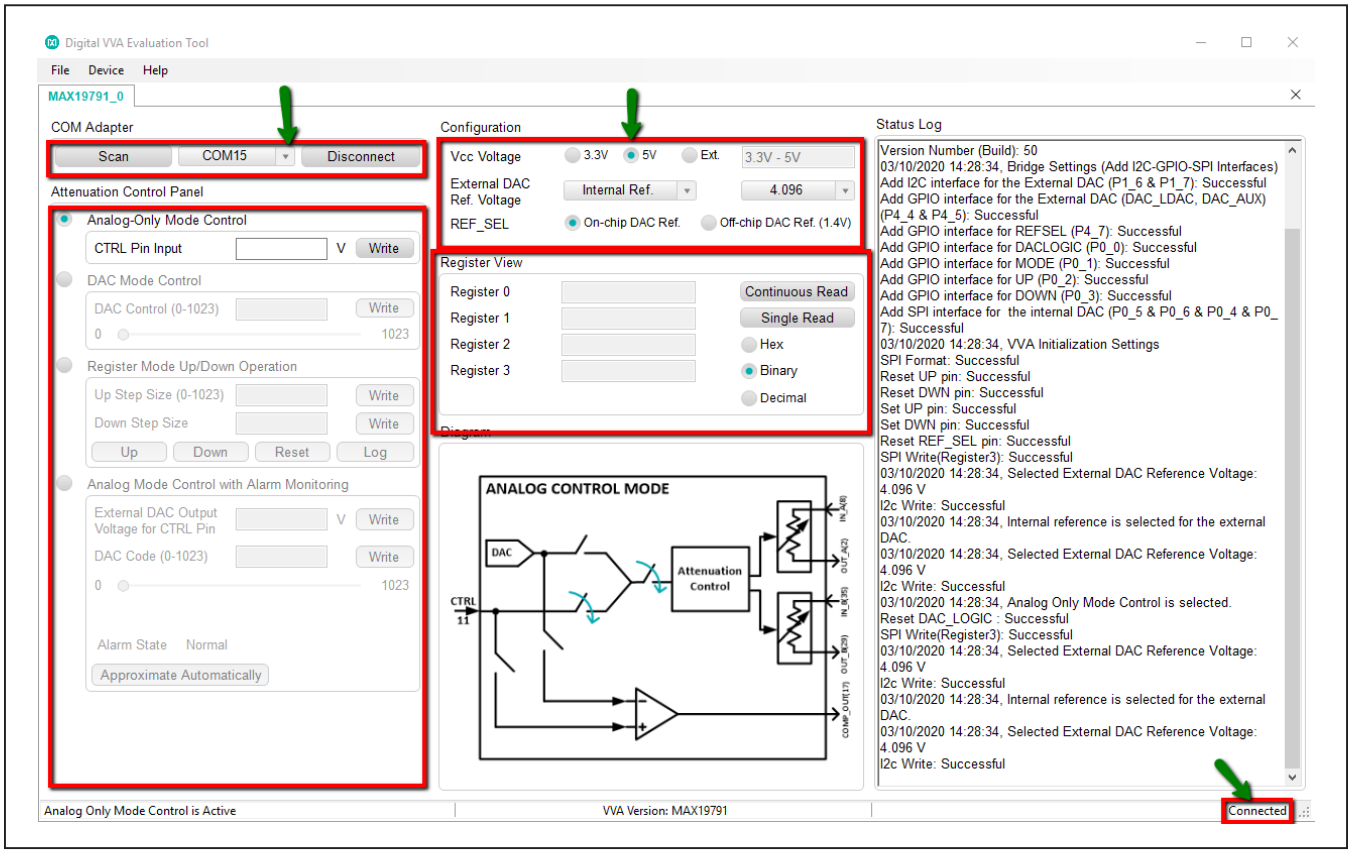


Figure 3. GUI View

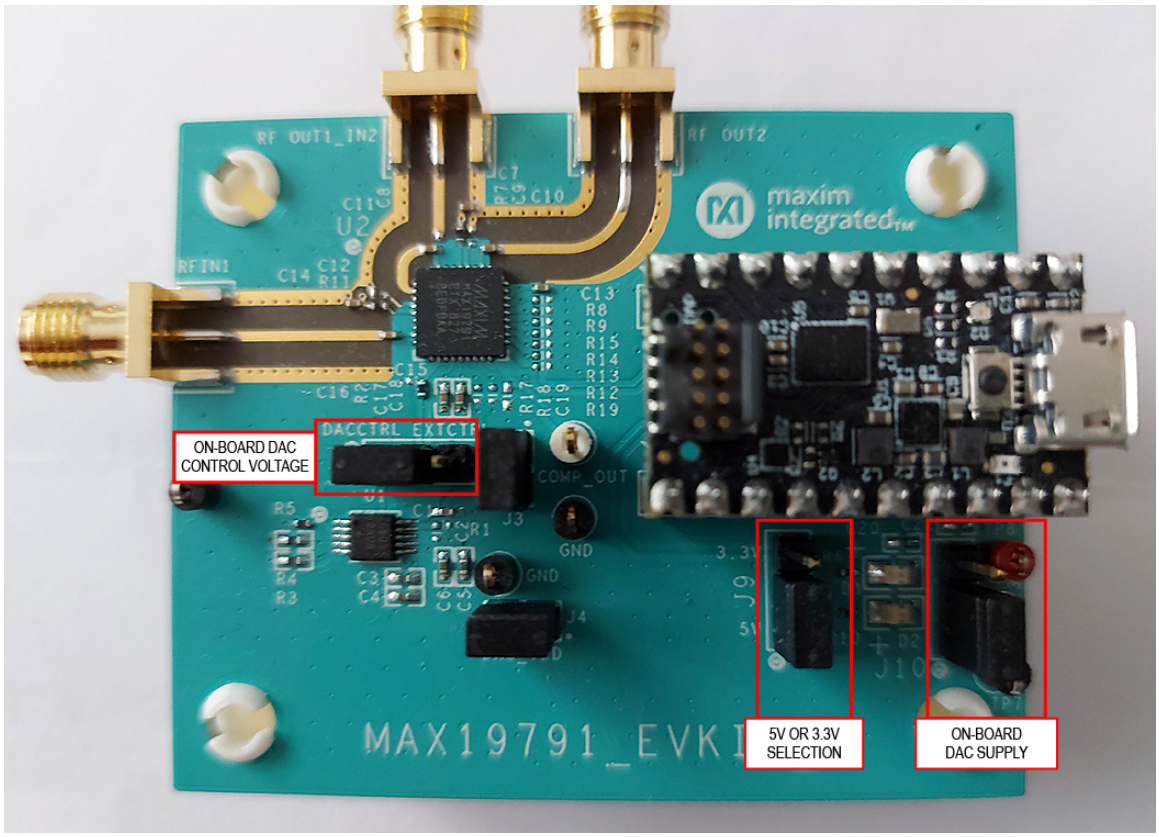


Figure 4. Connection Setup for Using On-Board Power Supply and On-Board Control Voltage

Verification of Different Modes

In the **Attenuation Control Panel**, click on the radio buttons for mode selection.

Analog-Only Mode Control:

- The control voltage can be applied via an external DAC or via a DC voltage source.
- To use the external DAC, set jumper J8 to position **DACCTRL** and enter the value (1V to 4V) into the **CTRL Pin Input** box and click on **Write**.
- To use an external DC voltage source, remove jumper J8, and connect a voltage source to pin 2 of J8, as shown in Figure 1.

DAC Mode Control:

Caution: Do not apply any voltage on the control pin.

- In this mode, attenuation is controlled by the internal 10-bit DAC. Users can access it by writing into the register 0 by using the **DAC Control** (0-1023) widget or by dragging the knob on the slider. Verify by reading the **Register 0** content by clicking **Continuous Read** button of the **Register View** panel.
- For example, write 540 and see the **Status Log** to see **SPI Write (Register0): Successful**. Now find the tone power to be -24.76dBm in the spectrum analyzer. Measured attenuation = 0-(-24.76) = 24.76dB.

Register Mode Up/Down Operation:

Caution: Do not apply any voltage on the control pin.

- In this mode, the 10-bit internal DAC register is loaded with the result of a mathematical operation based on Registers 1 and 2 with the help of pulses on the UP/DOWN pin.

$$(\text{DAC REGISTER}) = \sum_{i=1}^{m} (\text{REGISTER 1})i - \sum_{j=1}^{n} (\text{REGISTER 2})j$$

  The device is designed to produce no wraparounds when using **UP** and **DOWN** stepping so that the DAC code maxes out at 1023 or goes no lower than 0.
- Register 1 is loaded with the content to be added and register 2 is loaded with the amount to be subtracted. Cumulative addition or subtraction happens based on the up or down pulses. One can alter the values of Register 1 and 2 dynamically.
- For Example:
- Register1 is loaded with 100 and register 2 is loaded with 25.
- Then send an up pulse (click **Up**), loaded content is 100.
- For the second up pulse, DAC register content is 200 (100+100).
- Now for a down pulse (click **Down**), DAC register content is 175 (100+100-25).
- Now change register1 content to be 200, and generate an up pulse, DAC register content is 375 (100+100-25+200).
- Now write 35 into register 2, and generate a down pulse, DAC register content is 340 (100+100-25+200-35).
- Now generate an up pulse, DAC register content is 540 (100+100-25+200-35+200).

Component Suppliers

SUPPLIER	WEBSITE
Murata Mfg. Co., Ltd.	www.murata.com
Kemet Electronics Pvt Ltd	www.kemet.com
Citizen America Corp.	www.citizencrystal.com
Keystone Electronics Corp	www.keyelco.com
Sullins Electronics Corp.	www.sullinselectronics.com
Maxim Integrated	www.maximintegrated.com

Note: *Indicate that you are using the MAX19791 when contacting these component suppliers.*

- Check the final value written into the DAC by clicking on the **Log**. Now find the tone power to be -24.76dBm on the spectrum analyzer. Measured attenuation = 0-(-24.76) = 24.76dB
- Observe the same attenuation that they observed by writing 540 to register 0 in DAC control mode.

Analog Mode Control with Alarm Monitoring:

In this mode, attenuation control is achieved by means of the analog voltage applied on the CTRL pin. The on-chip switches are set to compare the DAC voltage to the CTRL voltage at the comparator input, the output of the comparator (COMP_OUT) trips from high to low when VCTRL exceeds the on-chip DAC voltage. Approximate the voltage on the control pin by clicking on the **Approximate Automatically** button.

For example, apply a voltage of 2.5V on the CTRL pin, and click on the **Approximate Automatically** button. Read the approximate voltage as 2.49V.

Layout Considerations

A good PCB is an essential part of an RF circuit design. The EV kit PCB can serve as a guide for laying out a board using the devices. Keep traces carrying RF signals as short as possible to minimize radiation and insertion loss. Use impedance control on all RF signal traces. The exposed paddle must be soldered evenly to the board's ground plane for proper operation. Use abundant throughputs beneath the exposed paddle and between RF traces to minimize undesired RF coupling. To minimize coupling between different sections of the IC, each V_{CC} pin must have a bypass capacitor with low impedance to the closest ground at the frequency of interest. Do not share ground vias among multiple connections to the PCB ground plane. Refer to the *Layout Considerations* section of the MAX19791 IC data sheet for more information.

Ordering Information

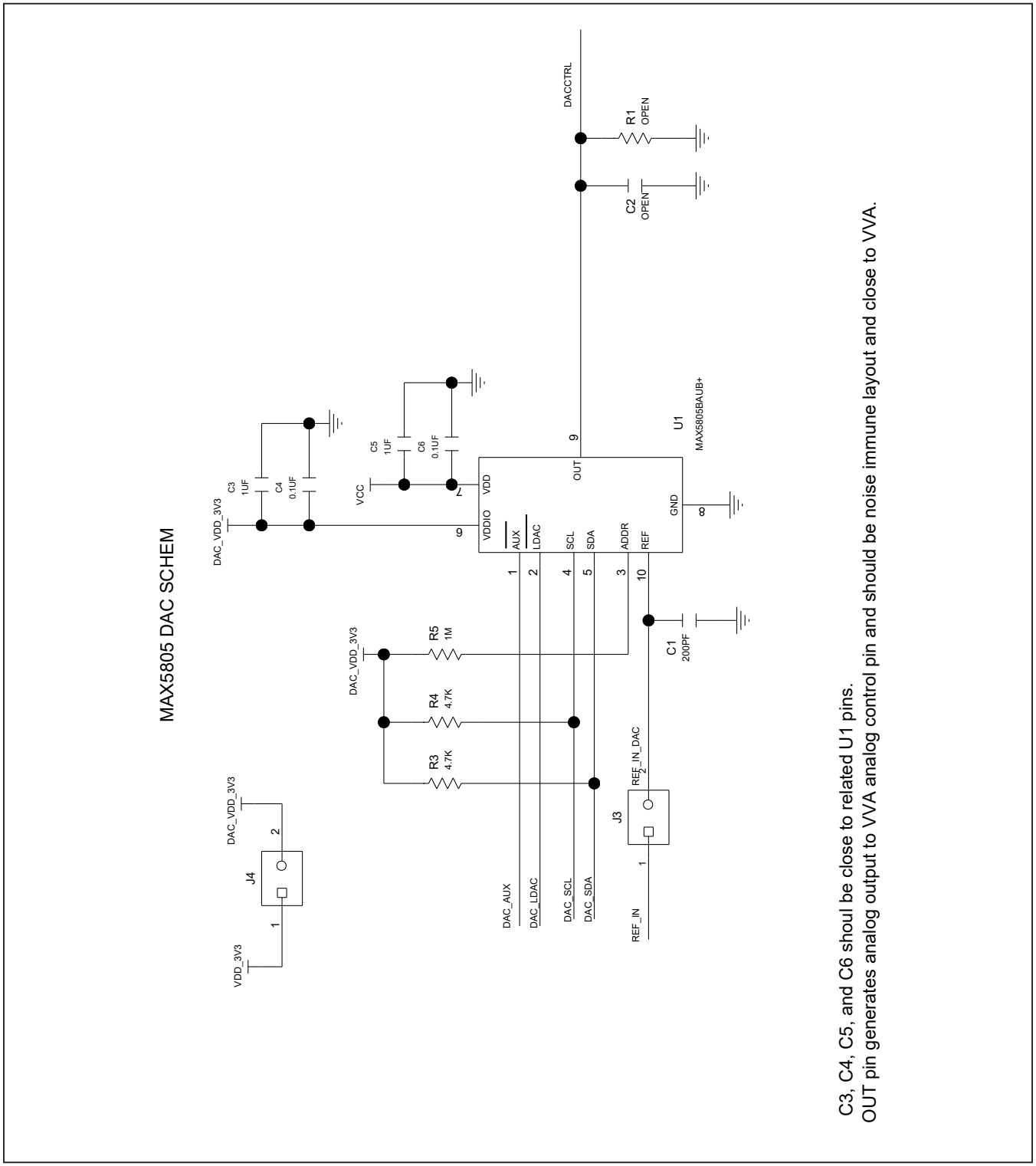
PART	TYPE
MAX19791EVKIT#	EV Kit

#Denotes RoHS compliance.

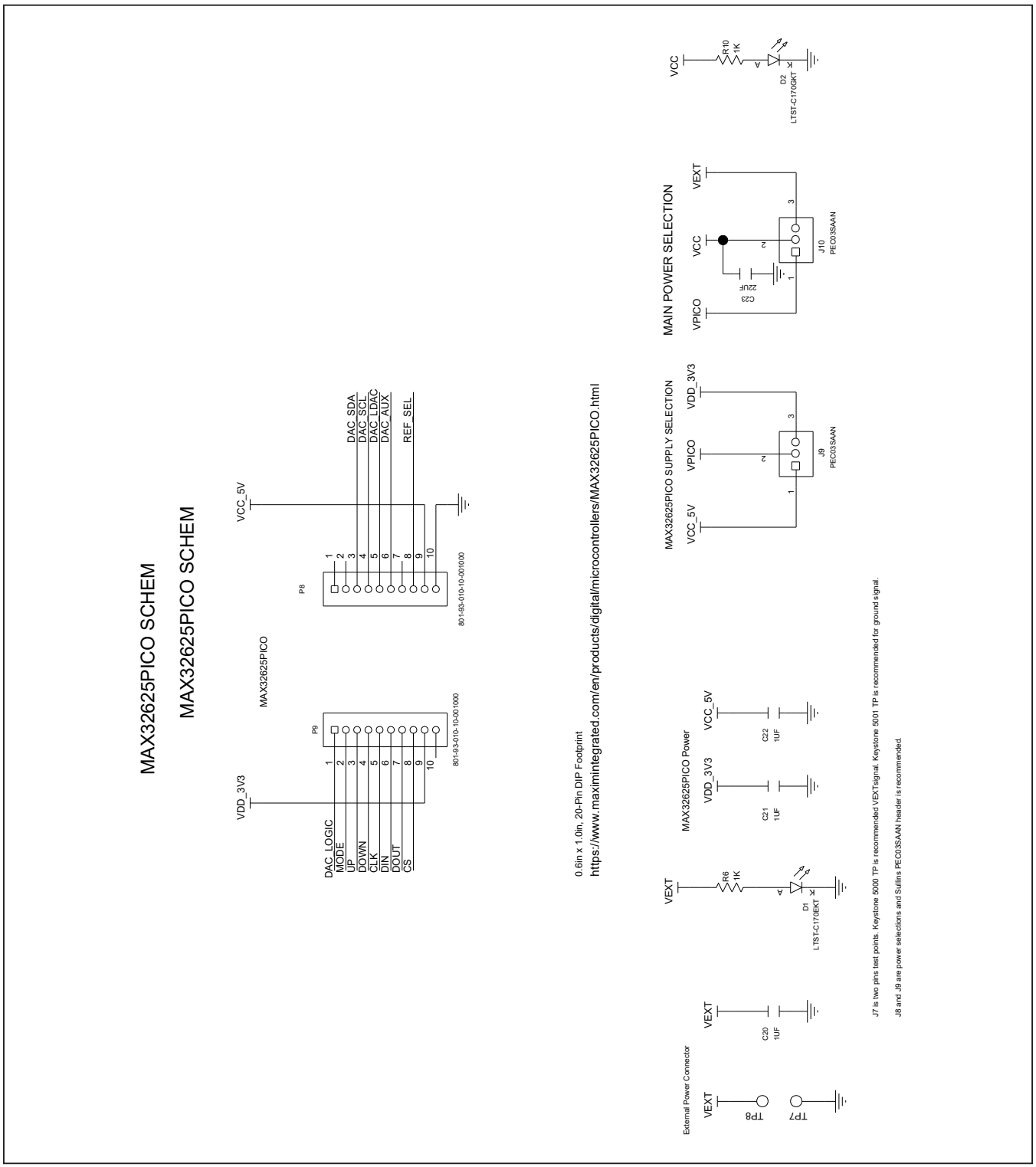
MAX19791 EV Kit Bill of Materials

ITEM	REF_DES		QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	C1		1	C0402C201J5GAC; GRM1555C1H201JA01	KEMET;MURATA	200PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 200PF;50V; TOL=5%; MODEL=; TG=-55 DEGC TO +125 DEGC; TC=C0G
2	C3, C5, C20-C22		5	EMK105BJ105KV	TAIYO YUDEN	1UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 1UF; 16V; TOL=10%; TG=-55 DEGC TO +85 DEGC; TC=X5R ;
3	C4, C6		2	GRM155R61C104KA88	MURATA	0.1UF	CAPACITOR; SMT (0402); CERAMIC; 0.1UF; 16V; TOL=10%; MODEL=GRM SERIES; TG=-55 DEGC to +85 DEGC; TC=X5R
4	C7, C13, C14, C17, C18		5	GRM155R71H102JA01; GCM155R71H102JA37	MURATA;MURATA	1000PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 1000PF; 50V; TOL=5%; MODEL=GRM SERIES; TG=-55 DEGC TO +125 DEGC; TC=X7R
5	C10, C11, C15		3	C0402X7R500-392KNE; GRM155R71H392KA01; C0402C392K5RACAUTO	VENKEL LTD.; MURATA;KEMET	3900PF	CAPACITOR; SMT (0402); CERAMIC CHIP; 3900PF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R
6	C23		1	JMK212BJ226KG	TAIYO YUDEN	22UF	CAPACITOR; SMT (0805); CERAMIC CHIP; 22UF; 6.3V; TOL=10%; MODEL=M SERIES; TG=-55 DEGC TO +85 DEGC; TC=X5R
7	COMP_OUT		1	5002	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE WIRE SILVER;
8	D1		1	LTST-C170EKT	LITE-ON ELECTRONICS INC	LTST-C170EKT	DIODE; LED; STANDARD; RED; SMT (0805); PIV=2.0V; IF=0.02A
9	D2		1	LTST-C170GKT	LITE-ON ELECTRONICS INC	LTST-C170GKT	DIODE; LED; STANDARD; GREEN; SMT (0805); PIV=2.1V; IF=0.01A
10	GND, TP2, TP5, TP7		4	5001	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
11	J1, J2, J5		3	132322	AMPHENOL	132322	CONNECTOR; FEMALE; BOARDMOUNT; SMA END LAUNCH RECEPT. JACK; 0.25IN SQUARE FLANGE; 0.062IN BOARD THICKNESS; STRAIGHT; 5PINS
12	J3, J4		2	PEC02SAAN	SULLINS	PEC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 2PINS
13	J6, J7		2	PBC10SAAN	SULLINS ELECTRONICS CORP.	PBC10SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 10PINS; -65 DEGC TO +125 DEGC
14	J8-J10		3	PEC03SAAN	SULLINS	PEC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT; 3PINS
15	KIT1		1	MAX32625PICO	MAXIM	MAX32625PICO	MODULE; BOARD; MAX32625PICO BOARD DESIGN FOR MAX32625 ARM CORTEX-M4F; BOARD; LAMINATED PLASTIC WITH COPPER CLAD;
16	MH1-MH4		4	9032	KEYSTONE	9032	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON
17	P8, P9		2	801-93-010-10-001000	MILL-MAX	801-93-010-10-001000	IC-SOCKET;SIP; STANDARD SOLDER TAIL; 801 SERIES; 0.024D/0.118L; 0.1IN GRID; STRAIGHT SOCKET; OPEN FRAME; 10PINS
18	R2		1	ERJ-2GEJ201	PANASONIC	200	RESISTOR; 0402; 200 OHM; 5%; 200PPM; 0.1W; THICK FILM
19	R3, R4		2	ERJ-2GEJ472	PANASONIC	4.7K	RESISTOR; 0402; 4.7K OHM; 5%; 200PPM; 0.10W; THICK FILM
20	R5		1	RC0402JR-071ML	YAGEO	1M	RES; SMT (0402); 1M; 5%; +/-100PPM/DEGC; 0.063W
21	R6, R10		2	ERJ-2GEJ102	PANASONIC	1K	RESISTOR; 0402; 1K OHM; 5%; 200PPM; 0.10W; THICK FILM
22	R7, R11		2	ERJ-2GEJ100	PANASONIC	10	RESISTOR; 0402; 10 OHM; 5%; 200PPM; 0.1W; THICK FILM
23	SU3, SU4, SU8-SU10		5	QPC02SXGN-RC	SULLINS ELECTRONICS CORP.	QPC02SXGN-RC	CONNECTOR; FEMALE; 0.100IN CC; OPEN TOP; JUMPER; STRAIGHT; 2PINS
24	TP8		1	5000	KEYSTONE	N/A	TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH;
25	U1		1	MAX5805BAUB+	MAXIM	MAX5805BAUB+	IC; DAC; ULTRA-SMALL; SINGLE-CHANNEL; 12-BIT BUFFERED OUTPUT VOLTAGE DACS WITH INTERNAL REFERENCE AND I2C INTERFACE; UMAX10
26	U2		1	MAX19791ETX+	MAXIM	MAX19791ETX+	IC; ATTEN; 50 MHZ TO 4000 MHZ DUAL ANALOG VOLTAGE VARIABLE ATTENUATOR WITH ON-CHIP 10-BIT SPI CONTROLLED DAC; TQFN36-EP
27	PCB		1	MAX19791	MAXIM	PCB	PCB:MAX19791
28	R1, R8, R9, R12-R15, R17-R19	DNP	0	N/A	N/A	OPEN	PACKAGE OUTLINE 0402 RESISTOR
29	C2, C8, C9, C12, C16, C19	DNP	0	N/A	N/A	OPEN	PACKAGE OUTLINE 0402 NON-POLAR CAPACITOR
TOTAL			58				

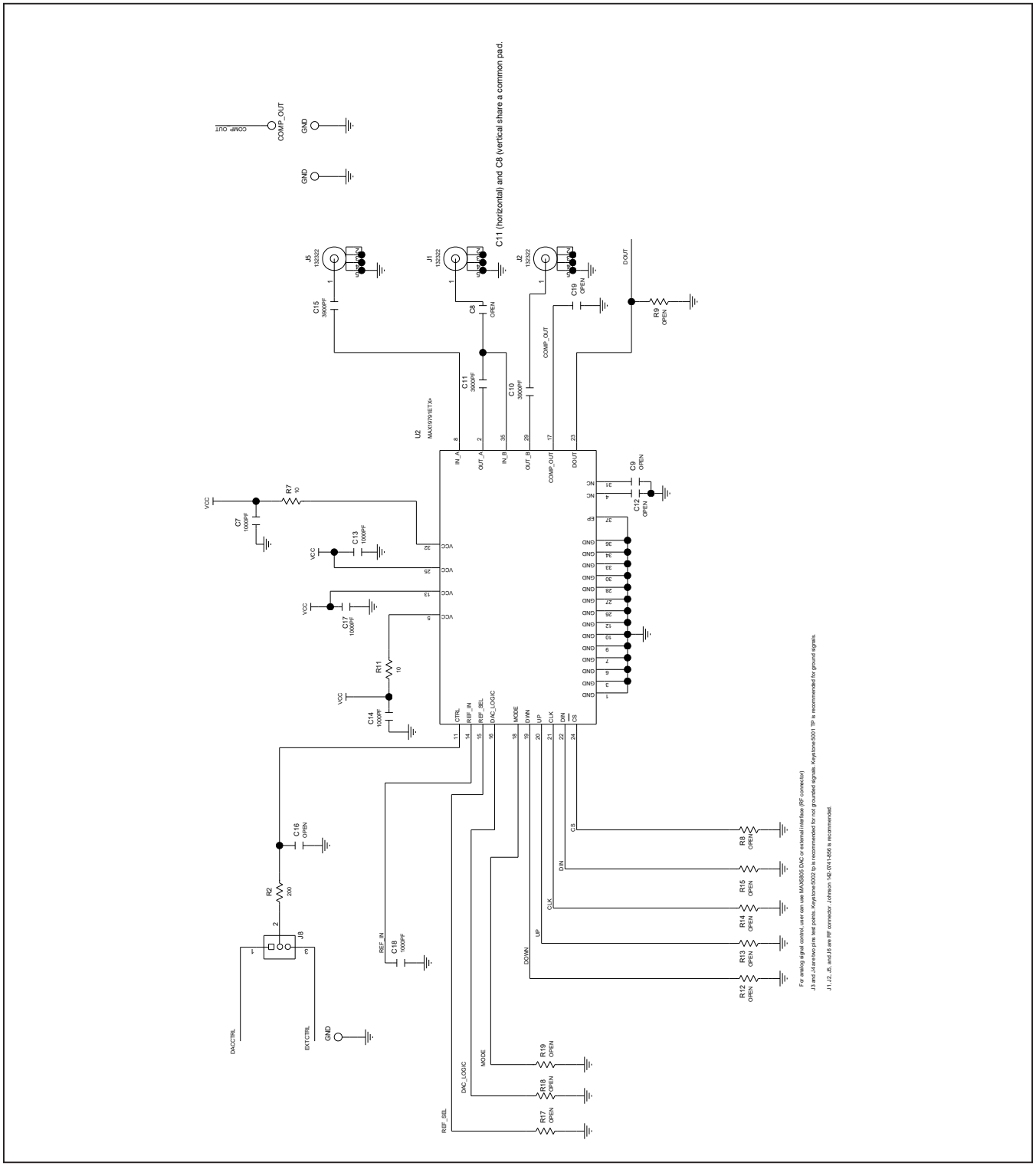
MAX19791 EV Kit Schematics



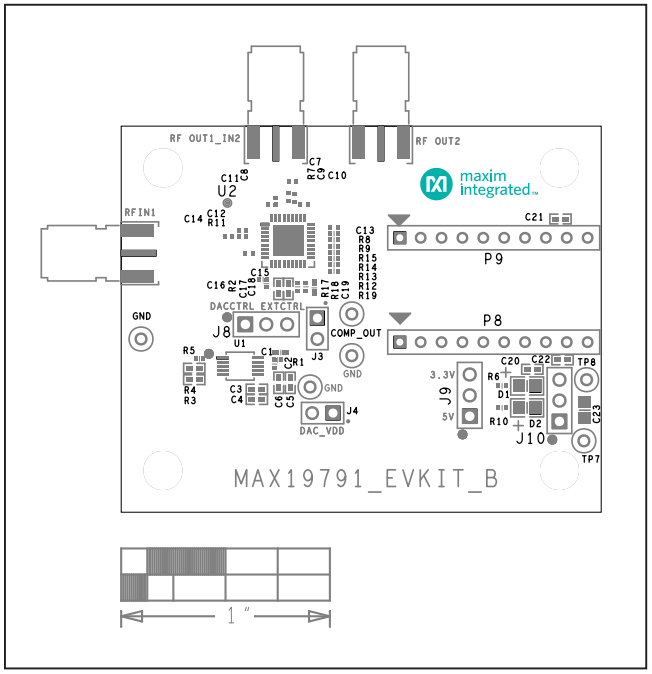
MAX19791 EV Kit Schematics (continued)



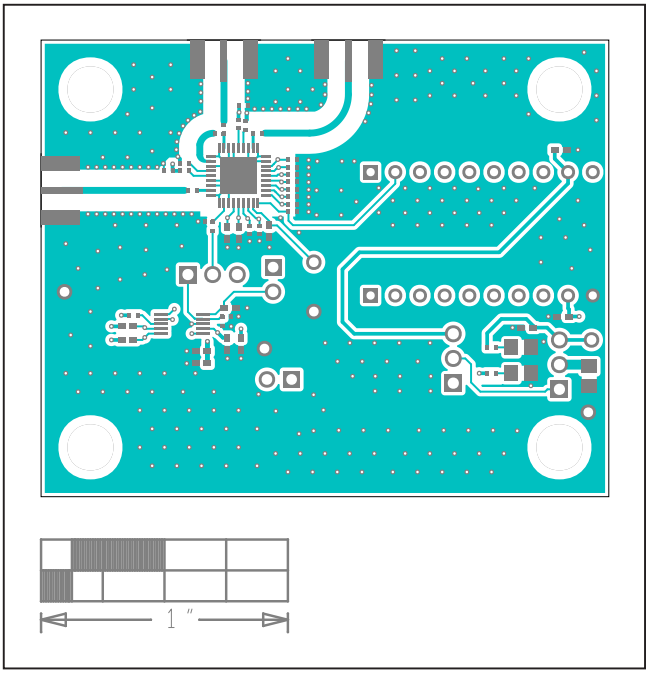
MAX19791 EV Kit Schematics (continued)



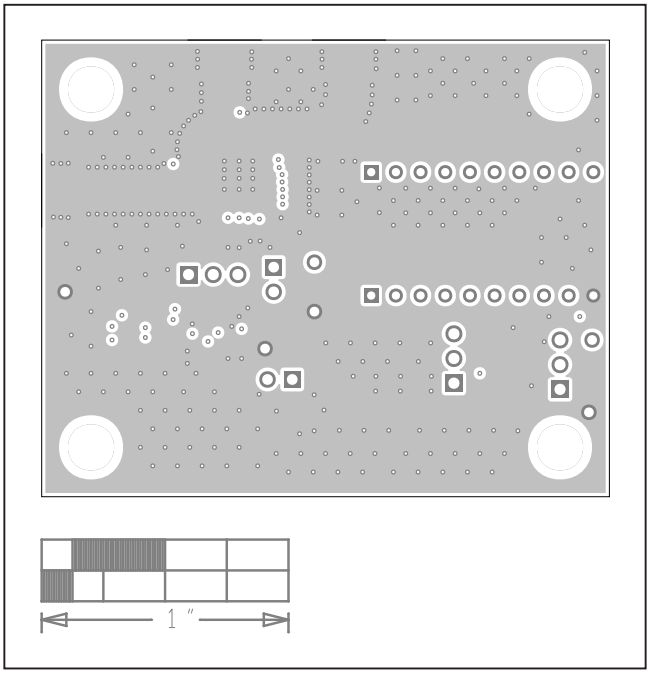
MAX19791 EV Kit PCB Layout Diagrams



MAX19791 EV Kit Component Placement Guide—Top Silkscreen

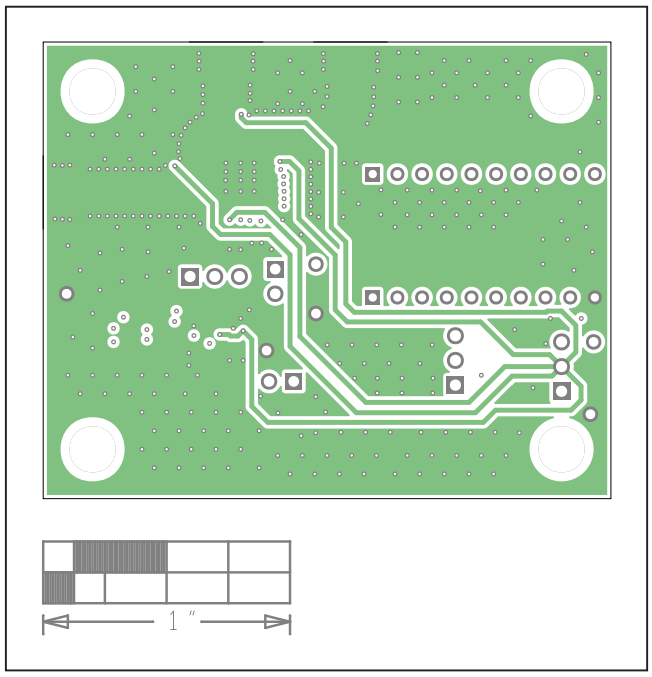


MAX19791 EV Kit PCB Layout—Top

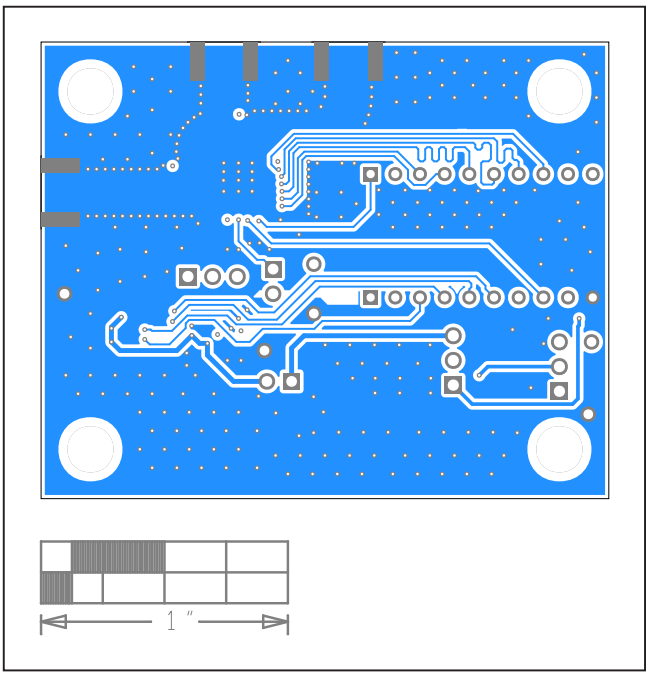


MAX19791 EV Kit PCB Layout—Internal 2

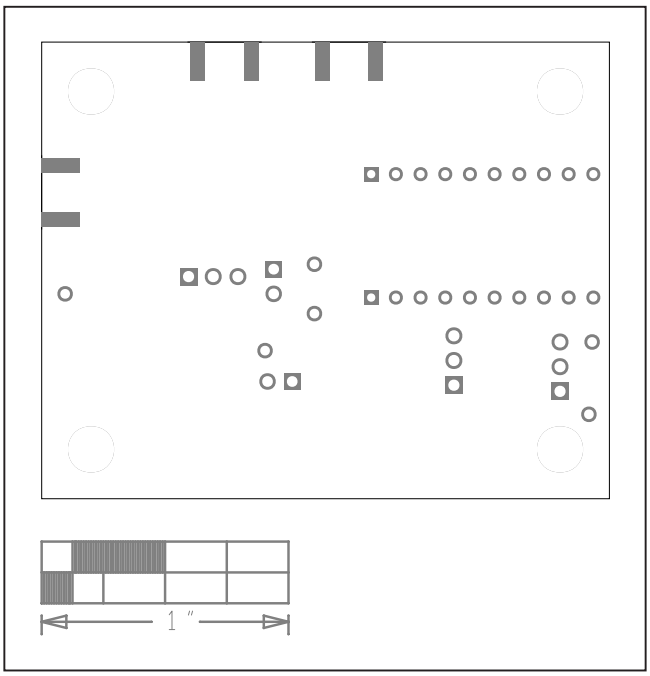
MAX19791 EV Kit PCB Layout Diagrams (continued)



MAX19791 EV Kit PCB Layout—Internal 3



MAX19791 EV Kit PCB Layout—Bottom



MAX19791 EV Kit PCB Layout—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/20	Initial release	—

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at https://www.maximintegrated.com/en/storefront/storefront.html.

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