

## General Description

The MAX15303 evaluation kit (EV kit) is a proven application circuit design for the MAX15303 digital DC-DC controller integrated circuit (IC). The EV kit allows the user to easily modify and test the EV kit with different operating conditions. The EV kit can be used as a standalone board if desired. However, to take full advantage of the IC's capability, the user must connect the EV kit to a PC with the Maxim PowerTool MAXPOWERTOOL002# USB-to-PMBus™ interface dongle and then control and monitor the EV kit with Maxim's digital PowerTool graphical user interface (GUI) software. The PowerTool GUI allows a PC to control the PMBus interface and to collect real-time data from the EV kit. The PowerTool is Windows XP®, Windows Vista®, and Windows®7 compatible. It provides a simple interface for exercising the features of the IC.

## Features and Benefits

- InTune™ Digital Point-of-Load (PoL) Switched-Mode Power Supply (SMPS)
  - Digital State-Space Control
  - Dual-Edge-Modulated Pulse-Width Modulation (PWM)
  - 300kHz to 1MHz Switching Frequency
  - 5V to 12V Input Voltage Range Using Linear Mode
  - 6.5V to 12V Input Voltage Range Using BabyBuck Mode
  - 0.6V to 3.3V Output Voltage Range
  - 6A Output Current Capability
  - Single-Phase Operation
- Pin-Strap or PMBus Configuration
- SMB Connectors for Low-Noise Measurements
- Connectors for Multiple-Rail Evaluation
- PMBus Interface for Control and Monitoring
- High-Speed Serial-Port Diagnostics

Ordering Information appears at end of data sheet.

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*InTune is a trademark of Maxim Integrated Products, Inc.*

*Windows, Windows XP, and Windows Vista are registered trademarks and registered service marks of Microsoft Corporation.*

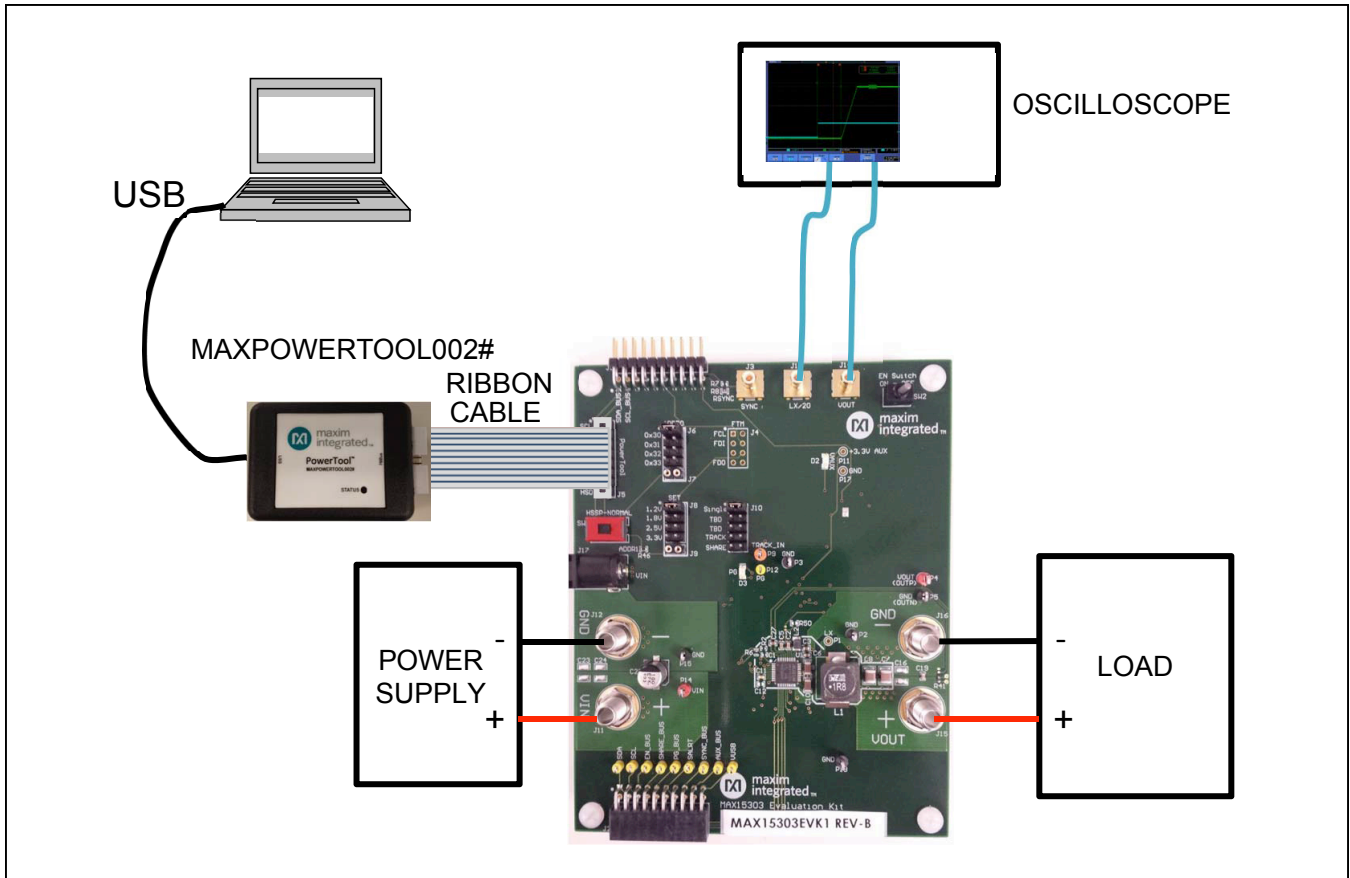


Figure.1 System Setup

### Quick Start

#### Required Equipment

- MAX15303 EV kit
- MAXPOWERTOOL002# USB-to-PMBus interface kit
- 6.5V to 12V, 5A DC supply
- 100MHz oscilloscope with  $\geq 2$  channels
- Electronic load
- Digital multimeters (DMMs)
- Windows XP, Windows Vista, or Windows 7 PC and an available USB port
- RG-174 BNC-to-SMB cables for oscilloscope connection

**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 and begin evaluation:

- 1) Visit [www.maximintegrated.com/evkitsoftware](http://www.maximintegrated.com/evkitsoftware) to download the latest version of the digital PowerTool software and PowerTool GUI, and follow the automated installation procedure.
- 2) Connect the MAXPOWERTOOL002# interface dongle to the PC using the supplied USB cable.
- 3) Complete the driver installation process for the USB-to-PMBus interface device.
- 4) Start the PowerTool GUI and verify that the GUI connects to the interface and that the interface device LED turns green.
- 5) Connect the power supply to one of the EV kit power input connectors using banana-plug test leads to J11 or by using a 2.5mm DC plug (center positive) to J17. Be careful to observe correct polarity.
- 6) Connect the load to the EV kit's power output

terminals (VOUT, J15) using banana-plug test leads or through the screw terminals.

- 7) Connect the oscilloscope to the VOUT (J14) and LX/20 (J13) connectors as desired, using the BNC-to-SMB coaxial cables. Note that the voltage at the LX connector is divided 20:1 from the actual LX voltage on the board. **Note:** Alternatively, connect using conventional scope probes.
- 8) Connect the PowerTool to J5 with the supplied 16-pin ribbon cable. Be sure the red stripe is at J5-1.
- 9) Check that the HSSP switch (SW1) is in the NORMAL position.
- 10) Set the EV kit output voltage with the supplied shunts on the J8 header (SET).
- 11) Set the EV kit SMBus slave address with the supplied shunts on the J6 header (ADDR0).
- 12) Set the EV kit to single-mode operation with the supplied shunts on J10.
- 13) Set the EV kit output-enable switch (SW2) to the OFF position.
- 14) Turn on the input power supply.
- 15) Click **Yes** on the GUI interface to force the GUI to rescan the bus addresses. The GUI should detect the EV kit and display a column of PMBus information for the MAX15303 device.
- 16) Enable the EV kit output by placing SW2 in the ON position, or by using the GUI PMBus enable control on the **Dashboard** tab.

## Detailed Description of Hardware

### Setting the Output Voltage

Configure the output voltage by connecting a resistance between the SET pin of the MAX15303 and GND (refer to Table 1 in the MAX15303 IC data sheet). Do this by placing a shunt across any one of the five-labeled locations of header J8 on the EV kit. Make additional pin-strap settings by removing the jumper from J8 and placing a leaded resistor across J9.

Once input power is applied to the EV kit, the SET resistor is read. The output-voltage set point can be changed at any time by sending a new VOUT\_COMMAND value from the GUI through the PMBus interface.

### Setting the PMBus Slave Address

Configure the EV kit slave address by connecting resistors between ADDR0 and GND and ADDR1 and GND on the IC (refer to Table 4a in the MAX15303 IC data sheet).

Resistor R46 on the EV kit connects to ADDR1, selecting both the address column and setting the current-limit voltage for the inductor DCR signal.

Select the ADDR0 resistor value, from one of four possible values, by placing a shunt in one of the labeled locations on header J6. Make additional pin-strap settings by removing the jumper from J6 and placing a leaded resistor across J7.

The ADDR0 and ADDR1 resistors are read once when input power is applied to the EV kit; the slave address cannot be changed through the PMBus interface.

### LED Indicators

The EV kit features two LED indicators, one to show that auxiliary power is present and one to show that the IC's output power is good.

The +3.3V VAUX LED (D2) illuminates green when the on-board 3.3V auxiliary supply is available. VAUX becomes available when an input voltage is applied to VIN at J11 or J17.

The PG LED (D3) illuminates green when the following conditions are met:

- VIN is present
- VAUX is present
- The IC asserts power good (PG pin is open)

### Enable Switch

The EV kit includes a switch (SW2) to control the IC's EN input. This switch has two labeled positions:

- ON: EN pin (EN\_BUS) is pulled high by the three-stated debounce circuit
- OFF: EN pin (EN\_BUS) is driven low by the debounce circuit

### HSSP-NORMAL Switch

The EV kit's HSSP-NORMAL switch (SW1) must be set to the NORMAL position for proper operation.

### SMB Connectors

The EV kit includes easy-to-use SMB connectors for precision monitoring of the output voltage (VOUT) at J14, and the switch node (LX) at J13. These connectors are back terminated with 50Ω resistance and can be connected directly to oscilloscope inputs for low-noise measurement.

**Note:** The LX signal passes through a 20:1 resistive divider to prevent noise propagation from the switch node and to protect the scope inputs from high voltage. Be sure to adjust the oscilloscope probe setup to account for this attenuation of the LX signal.

An additional SMB input connector is provided for the SYNC pin at J3, allowing an external clock source to be supplied to the IC.

### Output Current Calibration

One feature of the IC is the ability to report the actual load current. This functionality relies on properly calibrated IOUT\_CAL\_GAIN and IOUT\_CAL\_OFFSET values, which have been calculated and stored in the IC firmware during the EV kit production process. Any change to the output inductor requires recalibrating these parameters to ensure that the GUI reports an accurate output current. This is a simple process that is described in Application Note 5601: *Current Calibration Procedure for InTune Digital Power*, which is available on the Maxim website.

### System Evaluation with Multiple EV Kits

Multiple Maxim InTune EV kits can be coupled together to emulate a fully PMBus-enabled multiple-rail system. Each EV kit must be set to a different SMBus address. Power must be applied to each EV kit. Follow these steps to create a multiple-rail system:

- 1) Set the address for each EV kit by moving the address jumper.
- 2) Set the output voltage for each EV kit by moving the VOUT jumper (**Note:** VOUT can be changed later through the PMBus interface).
- 3) Connect multiple EV kits together using connectors J1 and J2.
- 4) Connect the PowerTool USB dongle to any one of the EV kits.
- 5) Apply a power connection to every EV kit.
- 6) Set the enable switches to the ENABLE or ON positions, except for one, which should be left in the DISABLE or OFF position. Note that the enable signals are combined together.
- 7) Apply the input voltage.
- 8) Start the PowerTool GUI to begin monitoring the devices.

[Figure 2](#) provides an example of one MAX15301 and two MAX15303 EV kits connected together.

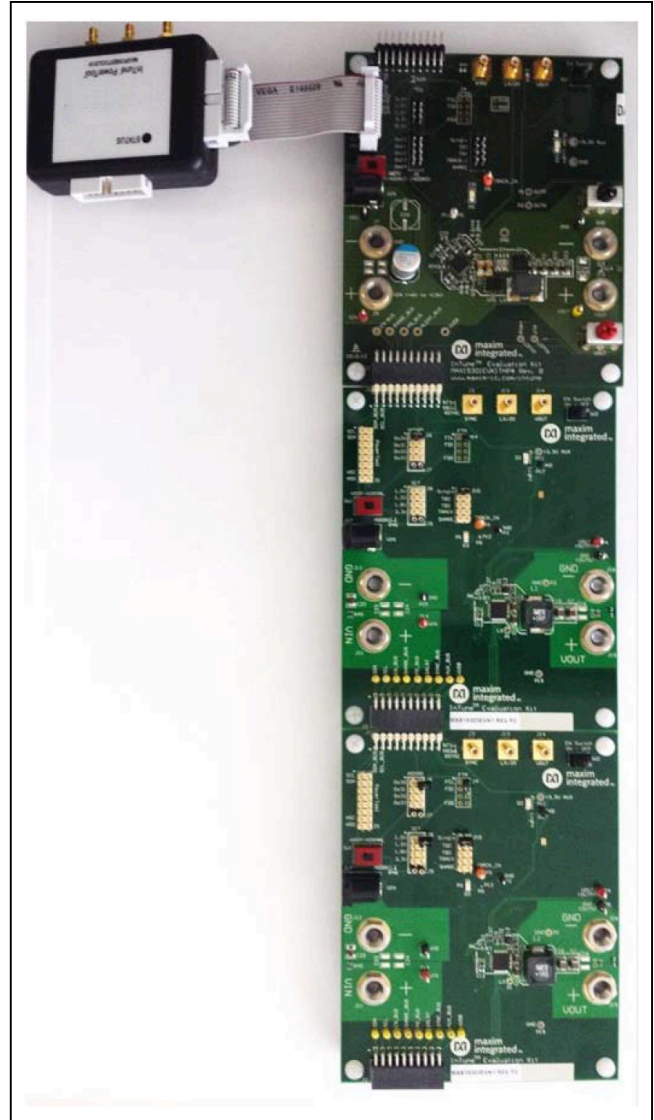


Figure 2. Multiple EV Kits Connected Together

Performance Characteristics

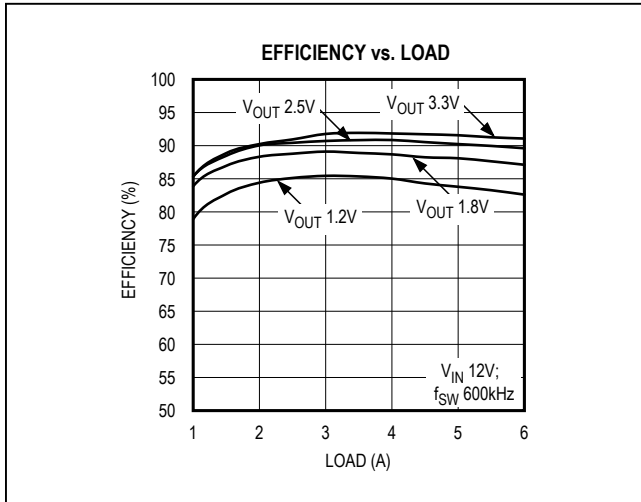


Figure 3. Efficiency vs. Load

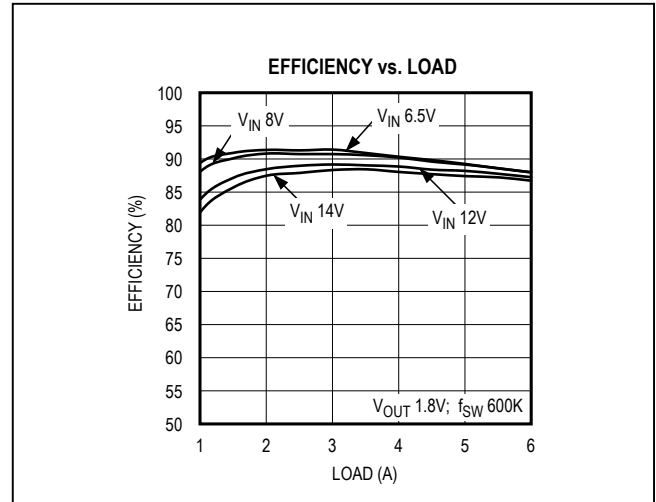


Figure 4. Efficiency vs. Load

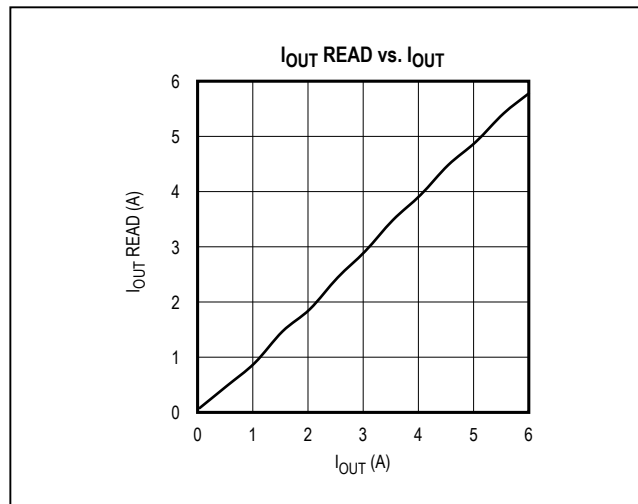


Figure 5. IOU\_T vs. Read\_IOU\_T

Performance Characteristics (continued)

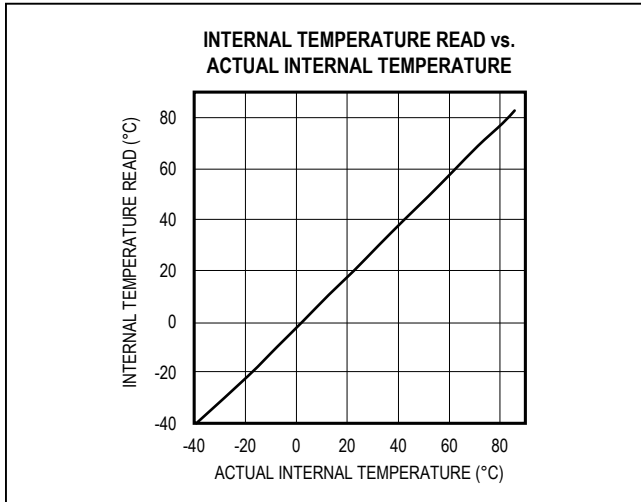


Figure 6. Internal Temperature Read vs. Internal Temperature

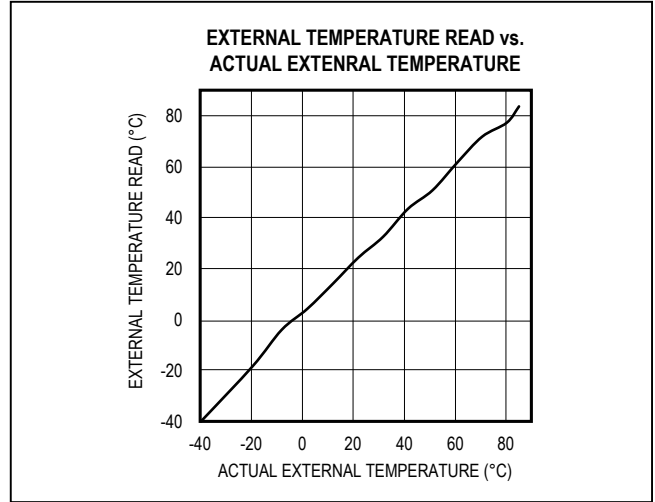


Figure 7. External Temperature Read vs. External Temperature

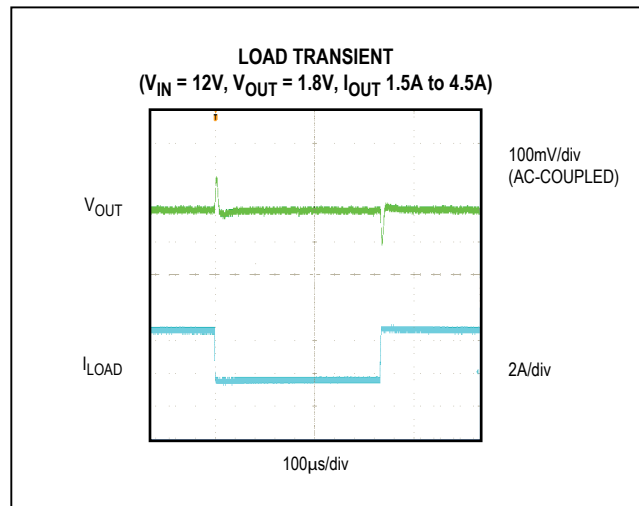


Figure 8. Load Transient

### Performance Characteristics (continued)

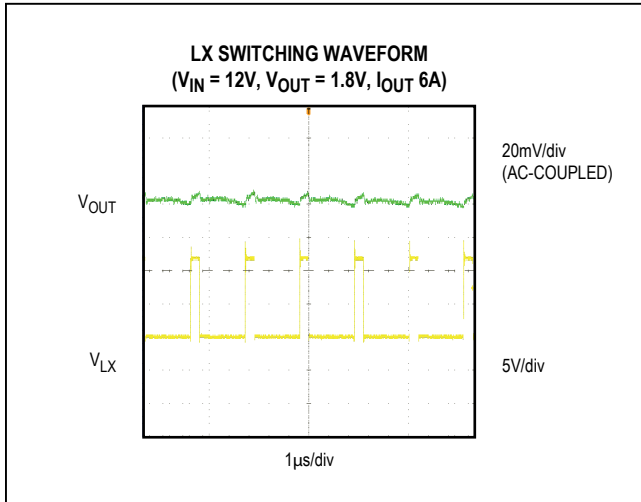


Figure 9. Output-Voltage Ripple

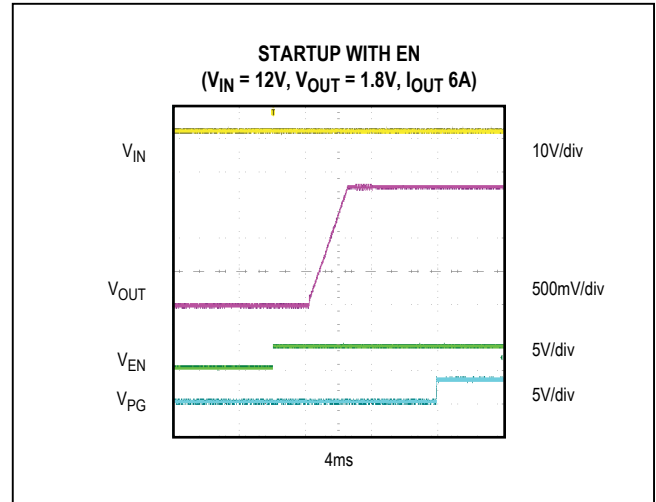


Figure 10. Startup Waveform

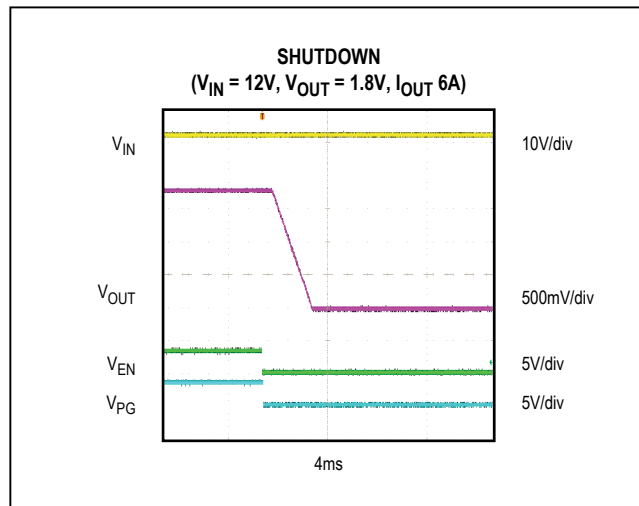


Figure 11. Shutdown Waveform

### Component List

Refer to file "15303EVK1\_RevC\_BOM.xlsx" attached to this PDF for component information.





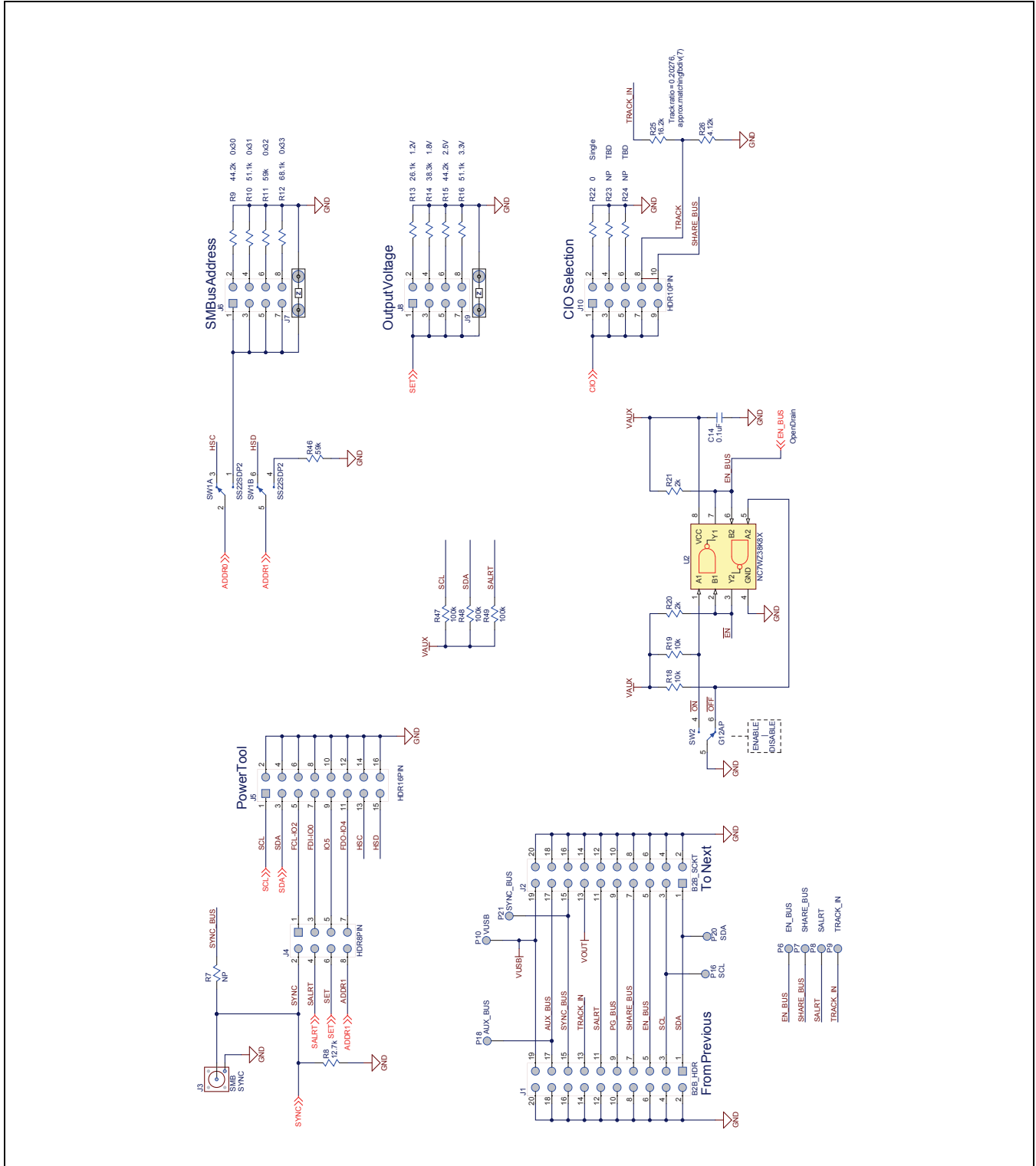


Figure 12b. MAX15303 EV Kit Schematic (Sheet 2 of 3)



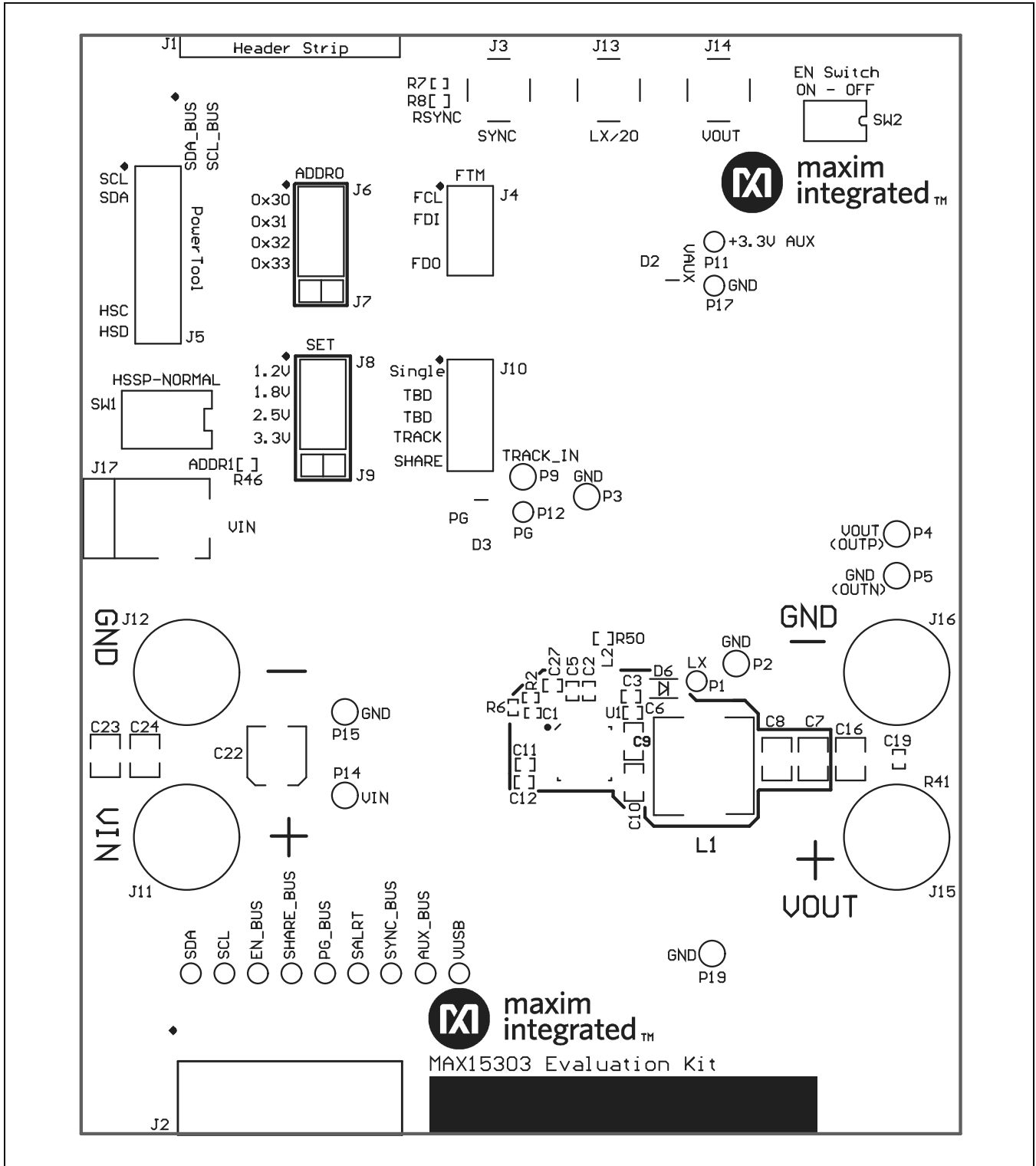


Figure 13. MAX15303 EV Kit Component Placement Guide—First Layer Assembly (Top View)

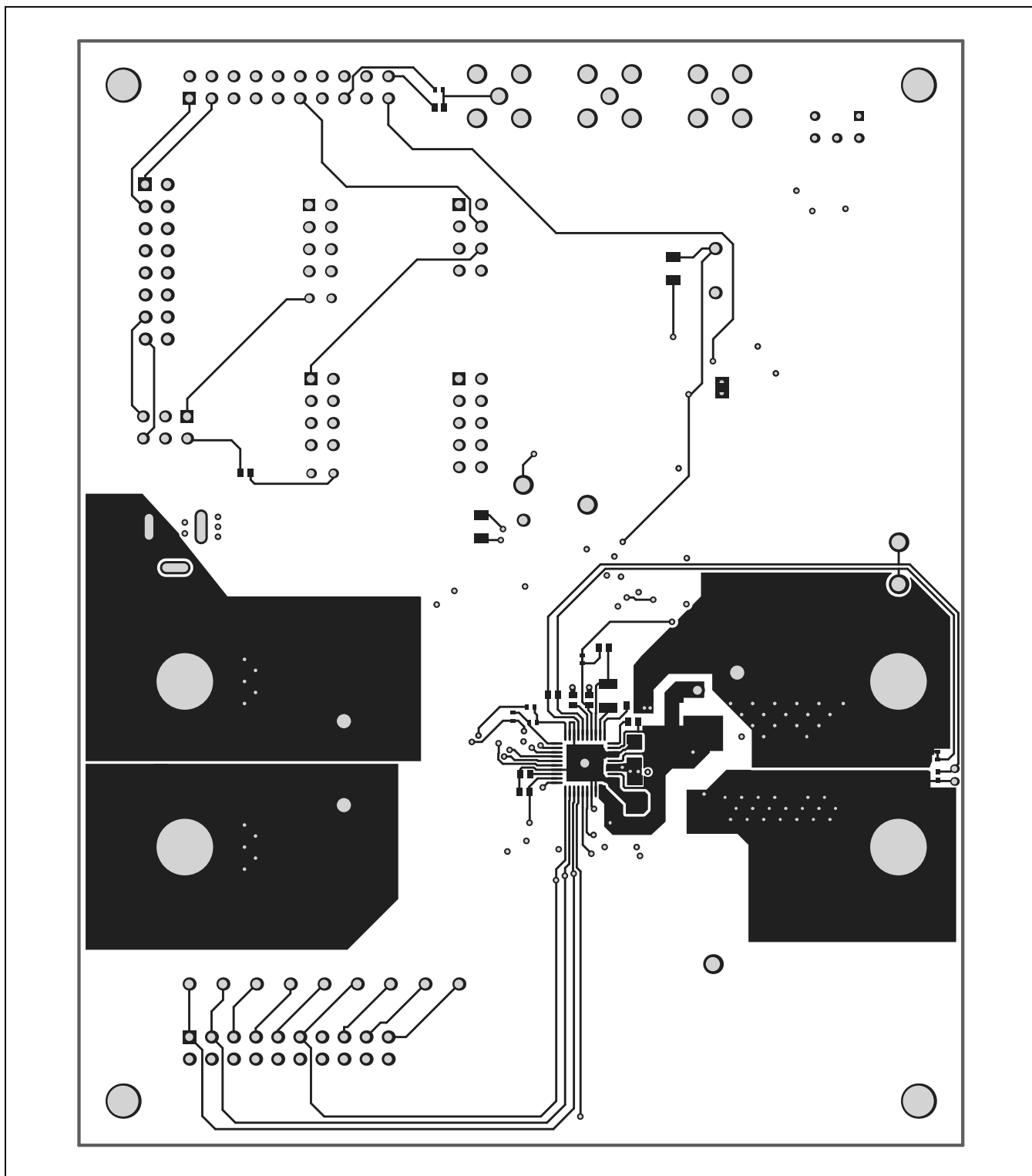


Figure 14. MAX15303 EV Kit PCB Layout—First Layer (Top View)

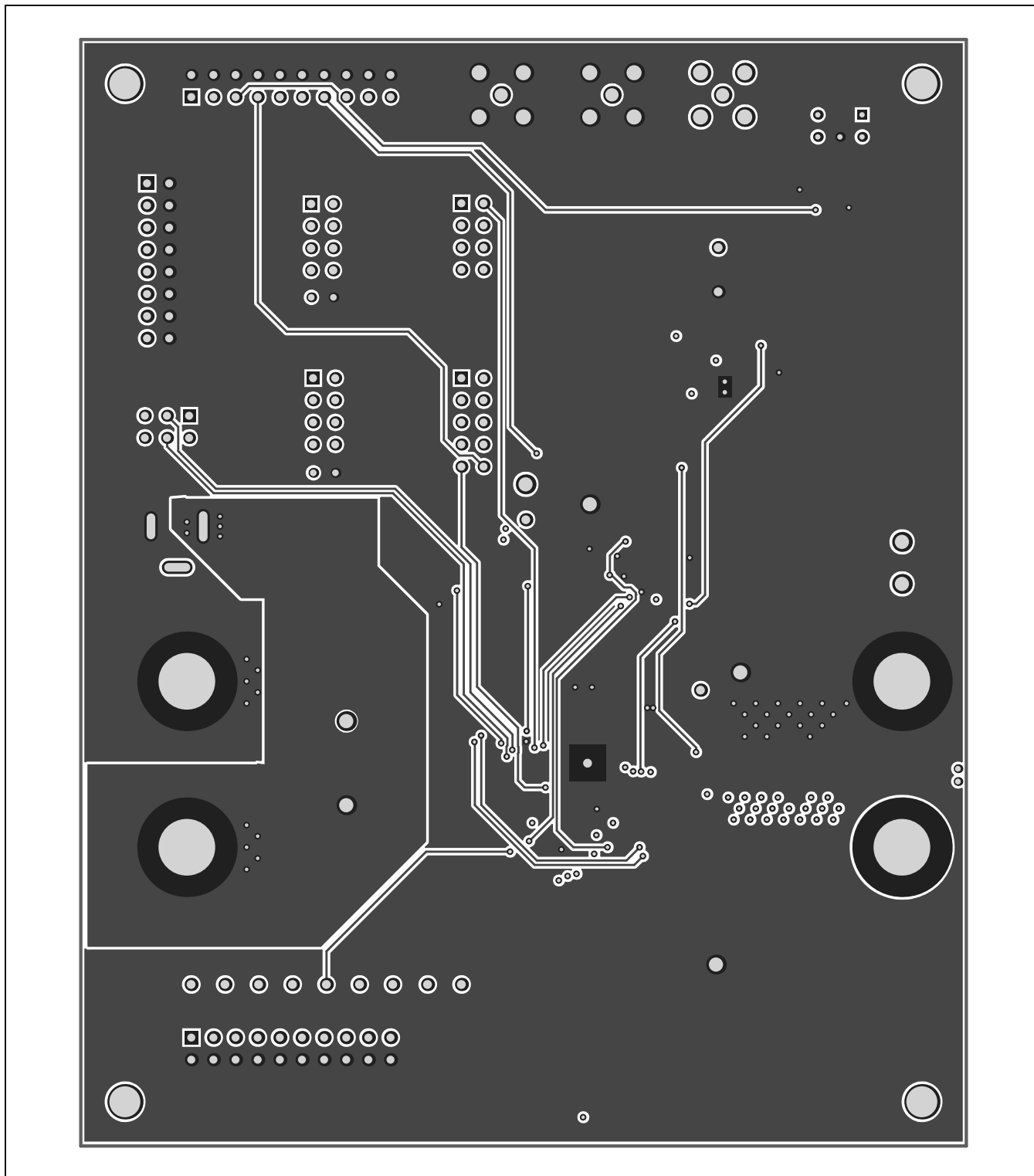


Figure 15. MAX15303 EV Kit PCB Layout—Layer 2 (Top View)

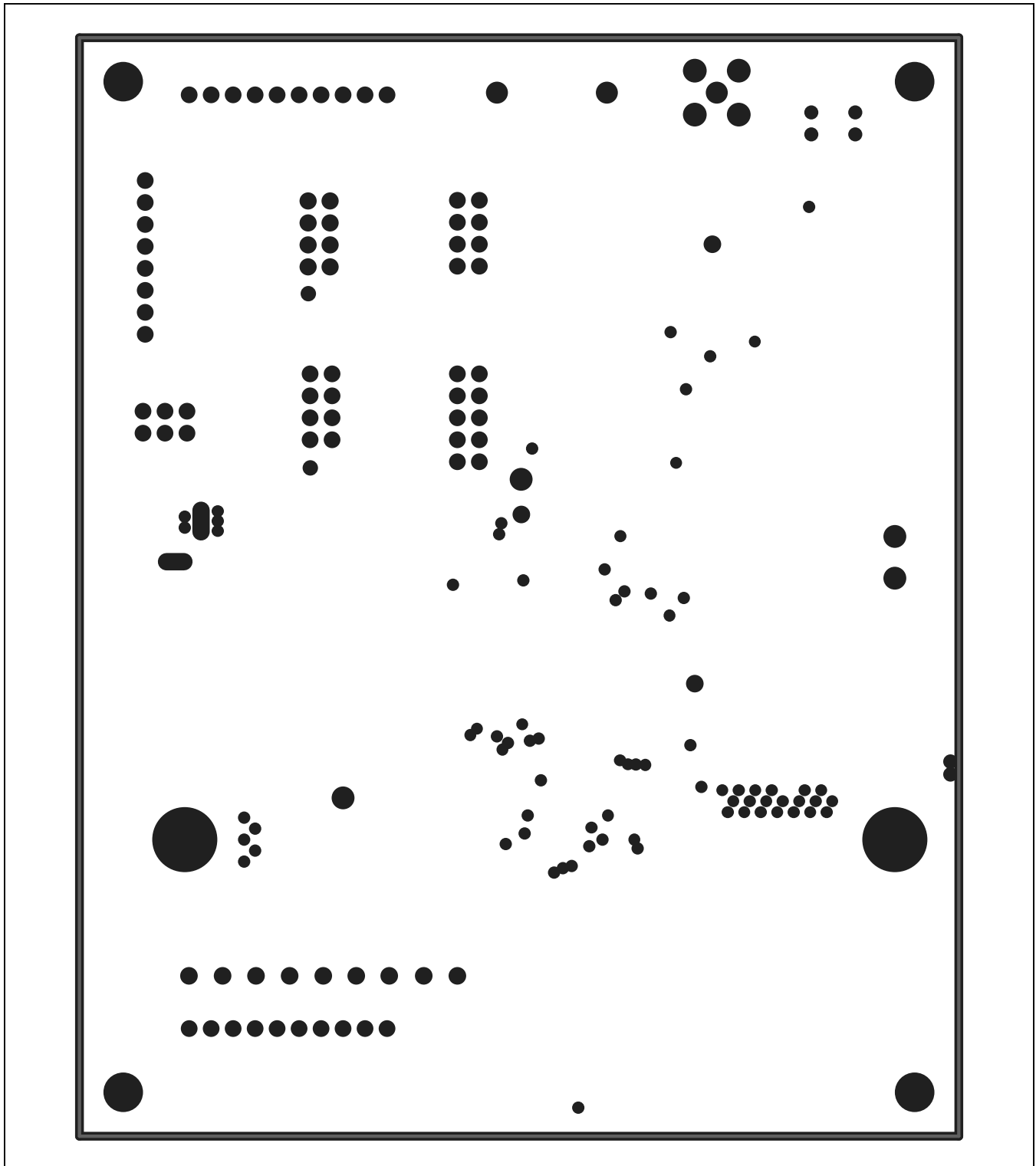


Figure 16. MAX15303 EV Kit PCB Layout—Layer 3 (Top View)

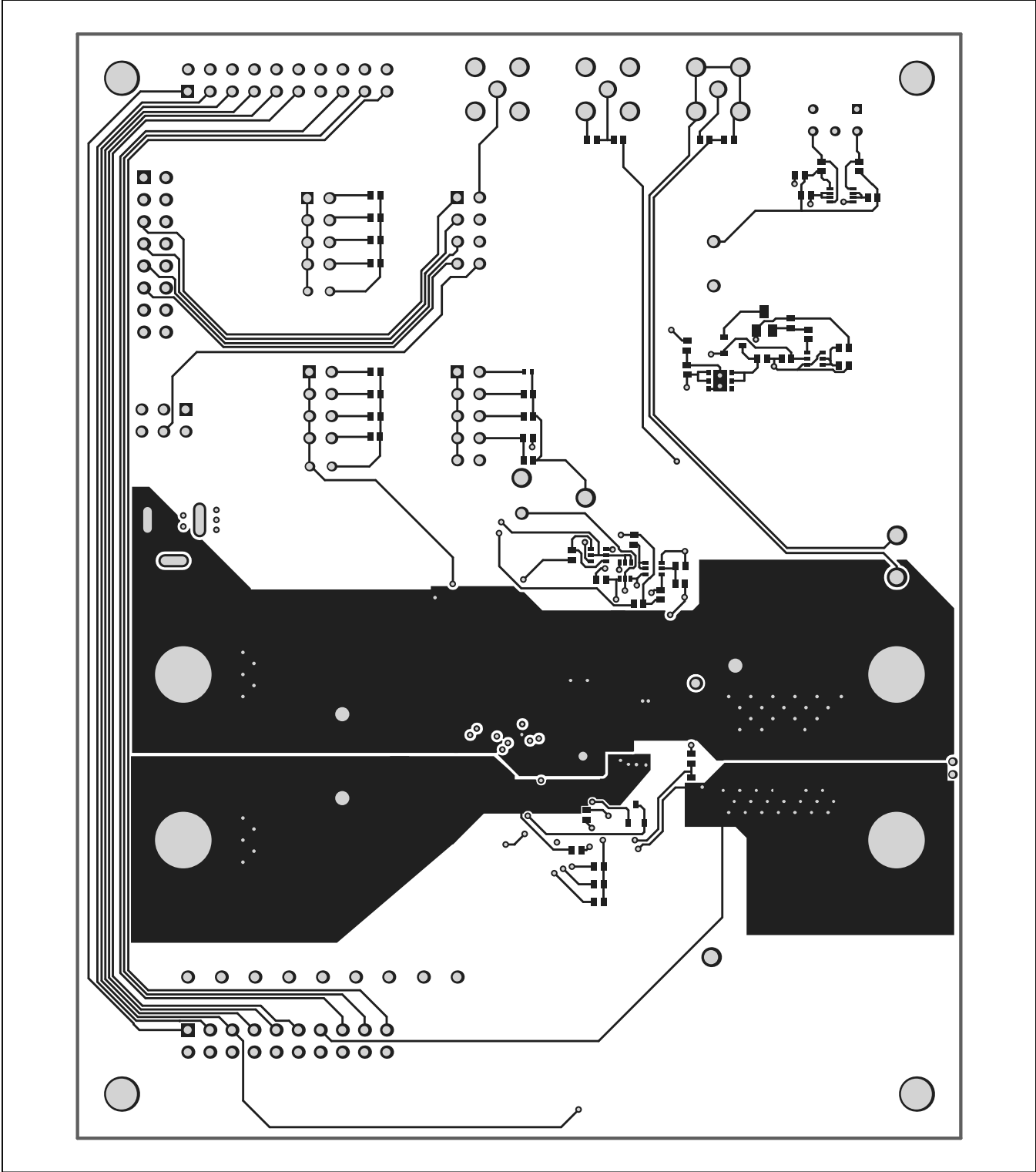


Figure 17. MAX15303 EV Kit PCB Layout—Bottom Layer (Top View)





### Ordering Information

PART	TYPE
MAX15303EVKIT1	MAX15303 EV Kit
MAXPOWERTOOL002#	PowerTool USB-to-PMBus Interface Dongle

#Denotes RoHS compliant.