19-5835; Rev 0; 4/11

MAX14566E Evaluation Kit

Evaluates: MAX14566AE/MAX14566BE/MAX14566E

General Description

The MAX14566E evaluation kit (EV kit) provides a proven design to evaluate the MAX14566E USB device that combines a Hi-Speed USB analog switch with a USB adapter emulator. The Hi-Speed USB transmission lines (D+/D-) have 90Ω differential impedance traces to meet Hi-Speed USB specifications.

The EV kit comes with the MAX14566EETA+ installed, but can also be used to evaluate the MAX14566AE and MAX14566BE with IC replacement of U1.

Features

- **Hi-Speed USB (480Mbps)**
- **90Ω Differential Traces for USB 2.0**
- **USB Powered or Externally Powered for Higher Charging Currents**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

Ordering Information appears at end of data sheet.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2, C4	3	1µF ±10%, 35V X7R ceramic capacitors (0805) Taiyo Yuden GMK212B7105K
C3, C5	2	1µF ±10%, 6.3V X5R ceramic capacitors (0603) TDK C1608X5R0J105k
C6, C7, C8	3	47µF ±20%,16V tantalum capacitors AVX TAJC476K016RNJ
C9	1	0.1µF ±10%, 50V X5R ceramic capacitor (0603) TDK C1608X5R1H104K
$\overline{CEN}$, U3_OUT, VHC	3	Red test points
D1	1	6V, 200mW zener diode (SOT323) Diodes Inc. MMBZ5233BW-7-F (Top Mark: KE3)
D2, D3, D4, D6	4	Green LEDs (0603)
D5	1	Red LED (0603)
GND	1	Black test point
J1	1	USB type-A right-angle female receptacle
J2	1	USB type-B right-angle female receptacle
JU1, JU2, JU5, JU7	4	2-pin headers
JU3, JU4, JU6, JU8	4	3-pin headers

DESIGNATION	QTY	DESCRIPTION
Q1	1	50V, 100mA npn transistor (3 SOT23)
R1, R3, R4, R7, R12, R16	6	330Ω ±5% resistors (0805)
R2	0	Not installed, resistor (0603)
R5, R13	2	0Ω ±5% resistors (0805)
R6	1	4.7kΩ ±5% resistor (0603)
R8	1	1kΩ ±5% resistor (0603)
R9	0	Not installed, resistor (0805)
R10, R11	2	10kΩ ±5% resistors (0603)
R14	1	93.1kΩ ±1% resistor (0603)
R15	1	100kΩ ±5% resistor (0603)
U1	1	USB adapter emulator (8 TDFN-EP) Maxim MAX14566EETA+ (Top Mark: ADJ)
U2	1	Noninverting buffer driver (6 SC70) Fairchild Semi NC7WZ07P6X (Top Mark: Z07)
U3	1	Adjustable current-limit switch (8 TDFN-EP) Maxim MAX14523AATA+ (Top Mark: BLO)
—	1	High-speed USB A-to-B cable
—	8	Shunts (JU1–JU8)
—	1	PCB: MAX14566E EVALUATION KIT

Component Suppliers

SUPPLIER	PHONE	WEBSITE
AVX Corporation	843-946-0238	www.avxcorp.com
Diodes Incorporated	805-446-4800	www.diodes.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com

Note: *Indicate that you are using the MAX14566E when contacting these component suppliers.*

Quick Start

Required Equipment

- MAX14566E EV kit (USB cable included)
- 5V, 2A DC power supply
- User-supplied PC with a spare Hi-Speed USB port
- USB 2.0 Hi-Speed/full-speed peripheral device (e.g., USB 2.0 flash drive)
- Mobile device (e.g., iPhone®, iPod®, MP3 player, etc.)

Procedure

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

1) Verify that all jumpers (JU1–JU7) are configured for pass-through mode (see Table 5).
2) Connect the USB cable from the PC to the USB type-B port (J2) on the EV kit.
3) Verify that LEDs D2, D4, and D6 are on.
4) Connect a USB 2.0 device to the USB type-A connector (J1).
5) Verify that the USB 2.0 device is detected by the PC.
6) Remove the shunt at jumper JU1. Verify that LED D2 turns off and the USB device is no longer detected.
7) Reinstall the shunt at jumper JU1. Verify that LED D2 turns on and the USB 2.0 device is detected by the PC.
8) The EV kit is now ready for further testing.

Detailed Description of Hardware

The MAX14566E EV kit provides a proven layout to evaluate the MAX14566E family of USB devices that combines a Hi-Speed USB analog switch with a USB adapter emulator. The EV kit provides type-A (J1) and type-B (J2) USB ports for data routing and peripheral charging. The EV kit requires an active USB port or an external 5V, 2A DC supply for operation.

The device's autodetection mode automatically identifies the type of portable device connected using its charger identification circuit. Requiring no external software, the device allows a host USB port to support USB Battery Charging Specification, Revision 1.2-compliant devices with shorted D+/D- detection, as well as Apple chargers using internal resistor-dividers for biasing data lines for Apple-compliant devices. The device also features a high-performance, Hi-Speed USB switch with low 4pF (typ) on-capacitance and low 4Ω (typ) on-resistance used in the pass-through mode.

Jumper JU1 configures the EV kit circuit for USB pass-through mode or autodetection mode. In pass-through mode, data signals are routed between USB port J2 to USB port J1 using 90Ω differential controlled-impedance traces, and status indicator LED D2 is on. In autodetection mode, the device's DP and DM pins are set for dedicated charging of the device connected at J1, and status indicator LED D2 is off. The EV kit circuit utilizes several jumpers for proper operation when evaluating the EV kit in pass-through mode or autodetection mode. See the *Pass-Through Mode* and *Autodetection Mode* sections for additional information.

The EV kit circuit utilizes the MAX14566E (U1) active-low $\overline{CEN}$ (or the MAX14566AE active-high CEN) output and the MAX14523A (U3) autoretry current-limit switch for current-limit protection and resetting the peripheral device connected at port J1. The switch current-limit threshold is set to 1.5A, providing larger charging currents when operating the EV kit using an external supply. The current-limit threshold can be reconfigured by replacing resistor R14. Status LED indicators D3 and D5 provide the status of U3's ON and $\overline{FLAG}$ input and output, respectively. Installed capacitors C6, C7, and C8 are available at port J1 and are used to simulate a true USB host output capacitance when operating the current-limit switch using an external supply at the VIN and GND PCB pads. Status indicator LED D6 turns on when valid bus power is available at port J1.

The EV kit can also be used to evaluate the MAX14566AE and MAX14566BE devices. See the *Evaluating the MAX14566BE* section for additional information for configuring the EV kit for pass-through mode or autodetection mode when evaluating the MAX14566BE.

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Power-Supply Configuration

The EV kit circuit derives its power from USB port J2 (VBUS) or an external 5V supply applied at the VIN and GND PCB pads. VBUS or VIN sets the EV kit VHC power-rail voltage using jumper JU3. VHC is the power source for the MAX14566E/MAX14566AE/MAX14566BE and the noninverting buffer driver (U2). LED D4 turns on and is brightly lit when the VHC power plane is above 3.3V. See Table 1 for proper JU3 configuration.

Jumpers JU4 and JU6 set the 5V bus power for port J1 using VBUS, VIN, or U3_OUT. LED D6 is on when a valid bus voltage is applied at port J1. In pass-through mode, the EV kit circuit uses port J2 bus voltage as the power source. In autodetection mode, the EV kit can use an external 4.75V to 5.25V power supply connected at VIN for higher charging current, if required for the device connected at J1. See Table 2 for proper JU4 and JU6 configuration.

VCC Power (JU2)

Jumper JU2 is available for monitoring the MAX14566E/MAX14566AE/MAX14566BE VCC input current. Install a shunt at JU2 for normal operation. Remove the shunt at JU2 and place an ammeter in series with the jumper pins to monitor the device supply current. See Table 3 for proper JU2 configuration.

Modes of Operation (MAX14566E/MAX14566AE)

Jumper JU1 configures the EV kit circuit for USB pass-through or autodetection mode by setting the proper logic level at the device's CB pin. In pass-through mode, LED D2 is on. In autodetection mode, LED D2 is off. The EV kit requires several jumper reconfigurations for USB pass-through and autodetection modes. See Table 4 for proper JU1 configuration.

See the *Evaluating the MAX14566BE* section for configuring the EV kit mode of operation when evaluating the MAX14566BE.

Pass-Through Mode

In pass-through mode, the device's positive data lines (TDP, DP) are shorted together and the negative data lines (TDM, DM) are shorted together, allowing the routing of data signals from port J2 to port J1. See Table 5 for proper jumper configuration for pass-through mode operation.

Autodetection Mode

The devices feature autodetection mode for dedicated chargers and a USB host.

In autodetection mode, the devices monitor the voltages at DM and DP to determine the type of device attached. If DM ≥ 2.3V (typ) and DP ≤ 2.3V (typ), the voltage stays unchanged. If DM < 2.3V (typ), the device's internal switch disconnects DM and DP from the resistor-divider and DP and DM are shorted together for dedicated charging mode. If DP > 2.3V (typ), the internal switch disconnects DM and DP from the resistor-divider and DP and DM are shorted together for dedicated charging mode. Once the charging voltage is removed, the short between DP and DM is disconnected for normal operation.

To configure the EV kit for autodetection mode, see Table 6.

Table 1. VHC Power-Plane Configuration (JU3)

SHUNT POSITION	VHC POWER PLANE SET BY
1-2	VBUS
2-3	VIN

Table 2. Power Supply Configuration (JU4, JU6)

JUMPER	SHUNT POSITION	EV KIT FUNCTION
JU4	1-2	VBUS power source for U3 input.
	2-3	VIN power source for U3 input.
JU6	1-2	U3_OUT power source for port J1.
	2-3	Port J1 power source dependent on JU4 setting. Current-limit switch (U3) bypassed.

Table 3. VCC Configuration (JU2)

SHUNT POSITION	EV KIT FUNCTION
Installed	Power applied at VCC input.
Not installed	VCC input current monitoring. Ammeter in series with jumper pins 1-2.

Table 4. EV Kit Operating Modes (JU1)

SHUNT POSITION	CB PIN	LED D2 STATUS	EV KIT OPERATION
Installed	Connected to VHC supply through resistor R5.	On	Pass-through mode. The USB data transfers between J2 and J1.
Not installed	Connected to ground through resistor R6.	Off	Autodetection mode. Peripheral device charging at J1.

Table 5. Shunt Configuration for Pass-Through Mode (JU1–JU7)

JUMPER	SHUNT POSITION	EV KIT FUNCTION
JU1	Installed	Pass-through mode.
JU2	Installed	Power applied at the VCC input.
JU3	1-2	VHC power plane set by VBUS.
JU4	1-2	VBUS input power source for U3.
JU5	Not installed	Reset function for the MAX14566BE. Shunt should remain uninstalled for MAX14566E/MAX14566AE evaluation.
JU6	1-2	U3_OUT power source for port J1.
JU7	Not installed	Capacitance load disconnected from port J1.

Table 6. Shunt Configuration for Autodetection Mode (JU1–JU7)

JUMPER	SHUNT POSITION	EV KIT FUNCTION
JU1	Not Installed	Autodetection mode.
JU2	Installed	Power applied at the VCC input.
JU3	1-2	VHC power plane set by VBUS.
JU4	2-3	VIN input power source for U3.
JU5	Not Installed	Reset function for MAX14566BE. Shunt should remain uninstalled for MAX14566E/MAX14566AE evaluation.
JU6	1-2	U3_OUT power source for port J1.
JU7	Installed	Capacitance load connected to port J1.

Jumper JU4 configures the EV kit for higher charging currents when using an external supply at the VIN and GND PCB pads. The EV kit maximum charging current is limited to 1.5A using the U3 current-limit switch. To reconfigure the EV kit to a lower charging current, replace resistor R14 and use the following equation:

$$R14\ (k\Omega) = \frac{141400}{I_{LIM}(mA)}$$

where I_{LIM} is the desired current-limit threshold in mA and R14 is in kΩ.

Enable the power supply connected at VIN. Connect a mobile device with a half-charged battery to the port J1 type-A connector. Read the value of the current sourced by the VIN power supply and compare it to the device charging specification. An unsuccessful charging recognition shows a current between 100mA and 200mA for a brief time interval.

Note: The EV kit works in autodetection mode when using VBUS as the sole power source. Most PCs supply more than 500mA; however, VBUS may be current limited to 500mA due to the USB current-limit specifications. When operating the EV kit using VBUS, verify that a shunt is not installed at jumper JU7 (capacitors C6, C7, and C8 disconnected from port J1).

Automatic Peripheral Reset (MAX14566E/MAX14566AE)

In addition to configuring the EV kit for pass-through or autodetection mode, jumper JU1 is also used for resetting the peripheral device connected at port J1. To perform a peripheral reset, remove and then reinstall the shunt at JU1 (or vice versa).

During a reset condition, the MAX14566E's active-low $\overline{CEN}$ output pulses high for 1s. Transistor Q1 turns on, pulling the U3 ON pin low, resulting in the momentary turn on of LED D3 and disconnection of the bus power at port J1 for the 1s period.

For the MAX14566AE, remove Q1 and install a 0Ω resistor at the 0805 PCB pad R9. During a reset condition, the MAX14566AE active-high CEN output pulses low for 1s. The U3 ON pin is pulled low, resulting in the momentary turn on of LED D3 and disconnection of the bus power at port J1 for the 1s period.

Evaluating the MAX14566BE

The MAX14566BE can be evaluated by replacing U1 with the MAX14566BE. The MAX14566BE has two digital inputs (CB and CB1) to configure the EV kit circuit for pass-through mode, autodetection mode, or forced dedicated-charge mode. In forced dedicated-charge mode, DP and DM are always shorted.

The EV kit requires a slight modification when evaluating the MAX14566BE device. To evaluate the MAX14566BE, perform the following:

- Remove transistor Q1 or resistor R9
- Install a 0Ω 0603 resistor at R2

Jumpers JU1 and JU8 configure the EV kit for pass-through, autodetection, or forced dedicated-charge mode. See Table 7 for proper JU1 and JU8 configuration.

Automatic Peripheral Reset (MAX14566BE)

Jumper JU5 is available for resetting the peripheral device connected at port J1 by disabling the current-limit switch and disconnecting the bus power from port J1. Install a shunt at JU5 and then remove the shunt at JU5 to perform a peripheral reset at port J1. LED D3 remains on while the shunt is installed at JU5. See Table 8 for JU5 configuration.

Table 7. MAX14566BE Operating Modes (JU1, JU8)

SHUNT POSITION		MAX14566BE OPERATING MODE
JU1 (CB)	JU8 (CB1)	
Not installed	2-3	Autodetection mode
Not installed	1-2	Forced dedicated-charge mode (DP/DM shorted)
Installed	X	Pass-through mode

X = Don't care.

Table 8. MAX14566BE Peripheral Reset (JU5)

SHUNT POSITION	U3 ON PIN	LED D3 STATUS	EV KIT OPERATION
Installed	Connected to ground through resistor R10.	On	Reset condition: J1 bus power removed.
Not installed	Connected to VBUS or VIN through series resistors R8/R10.	Off	Power applied at J1.

Table 9. Jumper Descriptions (JU1–JU8)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	Installed*	Pass-through mode. USB data transfer between J2 and J1.
	Not installed	Autodetection mode. Peripheral device charging at J1.
JU2	Installed*	Power applied at the VCC input.
	Not installed	VCC input current monitoring. Ammeter in series with jumper pins 1-2.
JU3	1-2*	VHC power plane set by VBUS.
	2-3	VHC power plane set by VIN.
JU4	1-2*	VBUS input power source for U3.
	2-3	VIN input power source for U3.
JU5	Installed	MAX14566BE evaluation (reset condition): J1 bus power removed.
	Not installed*	MAX14566BE evaluation: Power applied at port J1. **Note:** The shunt should remain uninstalled when evaluating the MAX14566E and MAX14566AE.
JU6	1-2*	U3_OUT power source for port J1.
	2-3	Port J1 power source dependent on jumper JU4 setting. Current-limit switch (U3) bypassed.
JU7	Installed	Capacitance load connected to port J1.
	Not installed*	Capacitance load disconnected from port J1.
JU8	1-2*	MAX14566BE evaluation. Sets the MAX14566BE operating modes with jumper JU1 (see Table 7).
	2-3	

**Default position.*

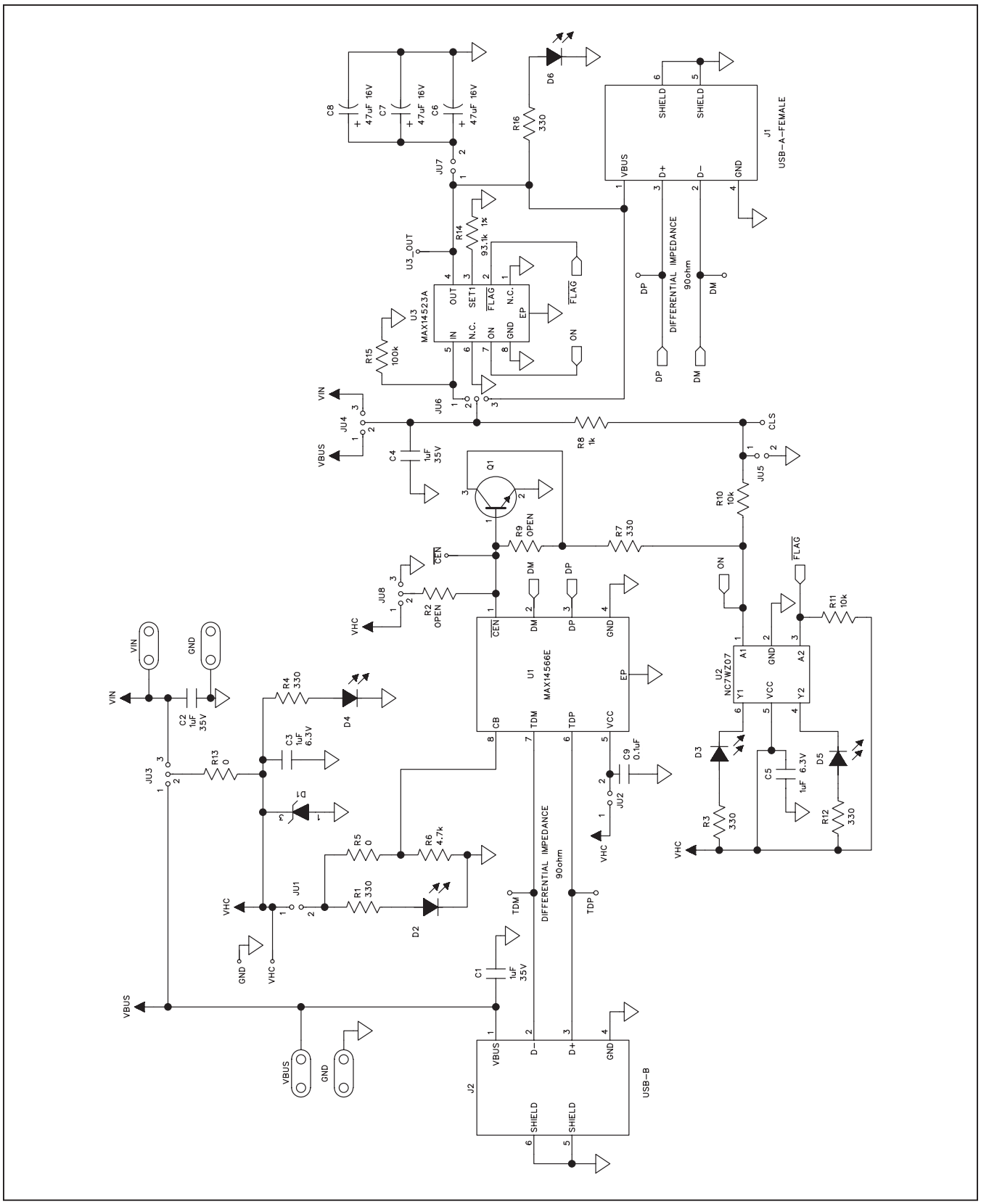

Figure 1. MAX14566E EV Kit Schematic

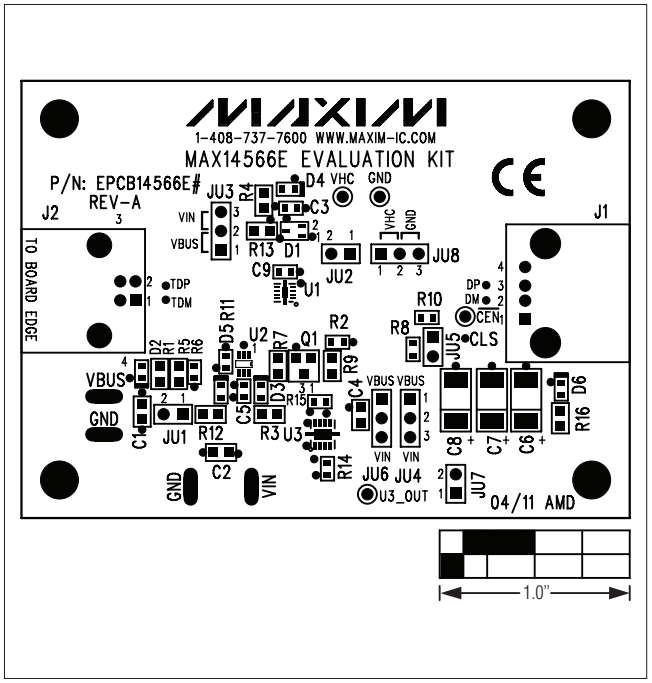

Figure 2. MAX14566E EV Kit Component Placement Guide—Component Side

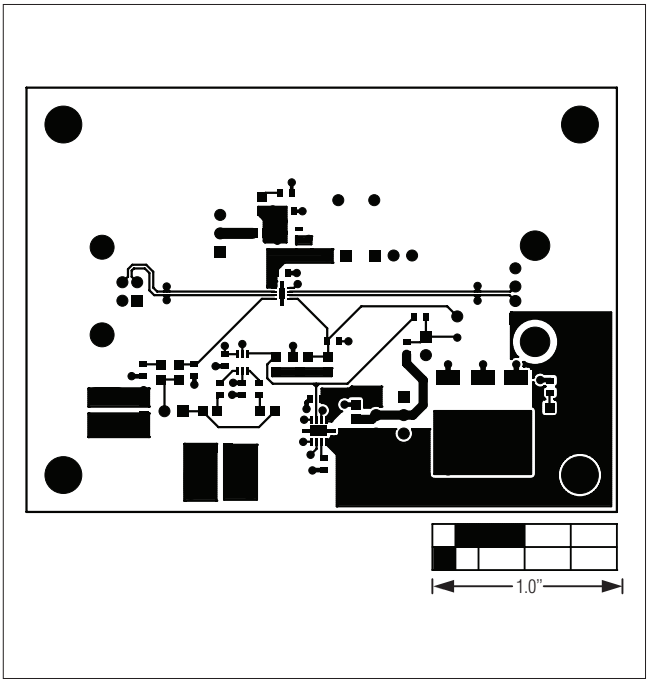

Figure 3. MAX14566E EV Kit PCB Layout—Component Side

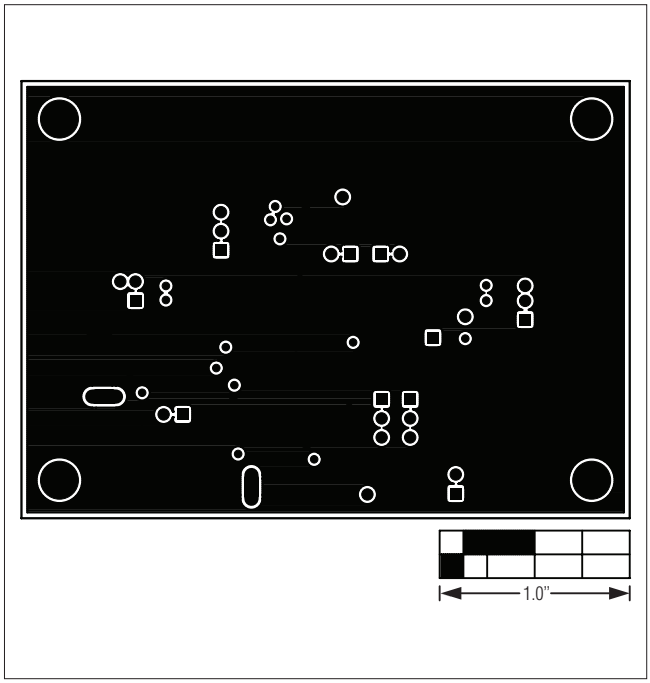

Figure 4. MAX14566E EV Kit PCB Layout—GND Layer 2

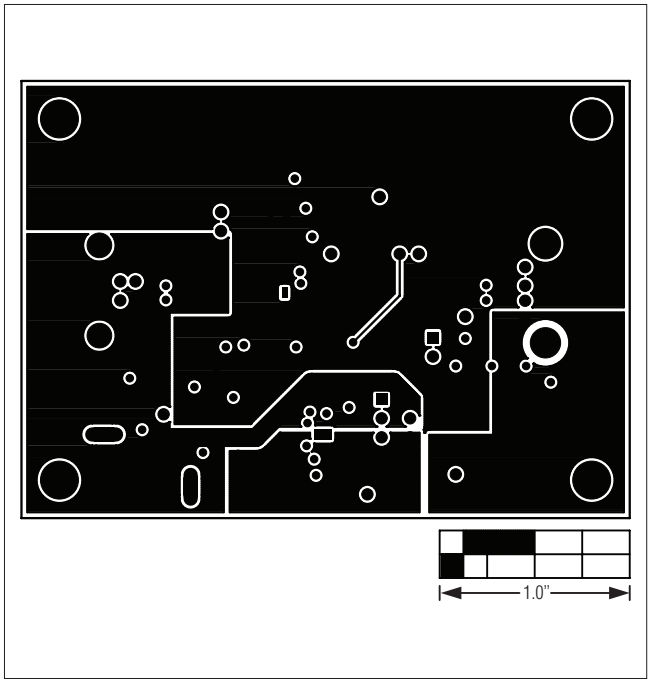

Figure 5. MAX14566E EV Kit PCB Layout—PWR Layer 3

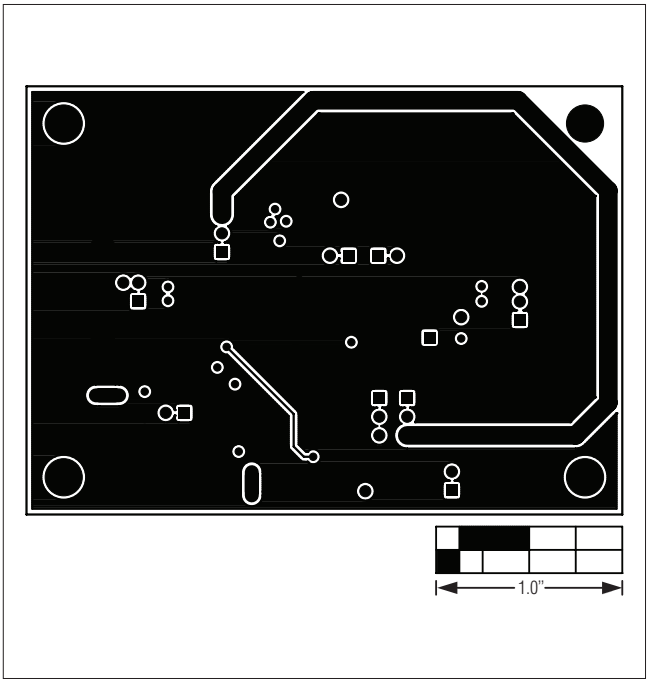

Figure 6. MAX14566E EV Kit PCB Layout—Solder Side

Ordering Information

PART	TYPE
MAX14566EEVKIT#	EV Kit

#Denotes RoHS compliant.

Revision History

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

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