19-4461; Rev 1; 4/09

Low-Resistance DPDT Switches with Negative Rail

General Description

The MAX14535E–MAX14539E are low on-resistance and high ESD-protected DPDT switches that multiplex analog signals, such as AC-coupled audio or video. These devices combine the low on-capacitance (C_{ON}) and low on-resistance (R_{ON}) necessary for high-performance switching applications in portable electronics, and include an internal negative supply to pass audio signals that swing below ground (down to -1.5V).

The MAX14535E/MAX14537E/MAX14539E feature internal shunt resistors on the normally open path (and normally closed path, (MAX14539E)) to reduce clicks and pops heard at the output. The MAX14535E–MAX14539E have an enable input (EN) to reduce supply current and set all channels to high-impedance when driven low. When EN is driven low, the MAX14537E/MAX14538E have the lowest possible current consumption, but cannot withstand negative rail signals. The MAX14535E/MAX14536E/MAX14539E can still withstand a negative signal to NC_, NO_, or COM_ from -1.5V to min (V_{CC}, 3V.)

The MAX14535E–MAX14539E operate from a +2.4V to +5.5V supply. These devices can be powered from the typical analog supply voltage in a cell phone (+2.5V to +2.8V) or a lithium-ion (Li+) battery (about 4.3V max). The MAX14535E–MAX14539E have high ESD protection, up to ±15kV on COM_, and the NC_, NO_, and COM_ voltage can go up to 3.6V when V_{CC} = 0 without damaging the devices.

All devices are offered in a space-saving, 10-pin, 1.4mm x 1.8mm UTQFN package, and operate over the -40°C to +85°C extended temperature range.

Applications

Cell Phones	Notebook Computers
MP3 Players	PDAs

Features

- **Low 0.135Ω (typ) On-Resistance**
- **Low 0.3mΩ (typ) R_{ON} Flatness**
- **Single +2.4V to +5.5V Supply Voltage**
- **Pass Audio Signal Between -1.5V and min (V_{CC}, 3V)**
- **Internal Shunt Resistors for Click-and-Pop Reduction (MAX14535E/MAX14537E/MAX14539E)**
- **Withstand 3.6V (max) Applied to NC_, NO_, and COM_ when V_{CC} = 0V**
- **High ESD Protection: Up to ±15kV on COM_**
- **10-Pin UTQFN (1.4mm x 1.8mm) Package**
- **-40°C to +85°C Operating Temperature Range**

Ordering Information/Selector Guide

PART	PIN-PACKAGE	TOP MARK	SHUNT RESISTORS	SHUTDOWN MODE (EN = LOW) SIGNAL RANGE
MAX14535EEVB+	10 UTQFN	AAS	NO1, NO2 Terminals	-1.5V to min (V_{CC}, 3V)
MAX14536EEVB+	10 UTQFN	AAT	—	-1.5V to min (V_{CC}, 3V)
MAX14537EEVB+*	10 UTQFN	AAU	NO1, NO2 Terminals	0 to V_{CC}
MAX14538EEVB+*	10 UTQFN	AAV	—	0 to V_{CC}
MAX14539EEVB+*	10 UTQFN	AAW	NO_ and NC_ Terminals	-1.5V to min (V_{CC}, 3V)

Note: *All devices are specified over the -40°C to +85°C temperature range.*

+Denotes a lead(Pb)-free package/RoHS-compliant package.

**Future product—contact factory for availability.*

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.

Low-Resistance DPDT Switches with Negative Rail

Detailed Description

The MAX14535E–MAX14539E are low on-resistance and high ESD-protected single DPDT switches that operate from a +2.4V to +5.5V supply and are designed to multiplex AC-coupled analog signals. These switches combine the low on-capacitance (C_{ON}) and low on-resistance (R_{ON}) necessary for high-performance switching applications. The negative signal capability of the analog channel allows signals below ground to pass through without distortion.

Analog Signal Levels

The MAX14535E–MAX14539E are bidirectional, allowing NO_, NC_, and COM_ to be configured as either inputs or outputs. Note that NC_ and NO_ are only protected against ESD up to ±2kV (Human Body Model) and may require additional ESD protection if used as outputs. These devices feature a charge pump that generates a negative supply to allow analog signals as low as -1.5V to pass through NO_, NC_, or COM_. This allows AC-coupled signals that drop below ground to pass even when operating from a 3.0V to 5.5V supply. For the MAX14537E/MAX14538E, the negative charge pump is controlled by the enable input and is active when EN is high. When EN is driven low, the negative charge pump is disabled, which puts the devices in the lowest possible current consumption, and the signal range is 0 to V_{CC}. The negative charge pump is always active for the MAX14535E/MAX14536E/MAX14539E, therefore, a negative signal (at most -1.5V) can be applied through NC_, NO_, or COM_, even when EN is driven low. A negative rail signal (signal voltage < 0) must not be applied to the switch unless the negative charge pump is active.

Digital Control Input

The MAX14535E–MAX14539E provide a single-bit control logic input, CB. CB controls the switch position as shown in the *Functional Diagrams*. Drive CB rail-to-rail to minimize power consumption.

Enable Input

The MAX14535E–MAX14539E feature a shutdown mode that reduces the supply current (less than 1µA for MAX14537E/MAX14538E) and places the switches in high impedance. Drive EN low to place the device in shutdown mode. Drive EN high for normal operation.

Shunt Resistors (MAX14535E/MAX14537E/MAX14539E)

When EN is high, the shunt resistors are controlled by CB. When CB is low, NC_ is connected to COM_ and NO_ is connected to shunt resistors. When CB is high, NO_ is connected to COM_ and NC_ is connected to shunt resistors (MAX14539E). When EN is low, all the switches are open and all the shunt resistors are active.

Click-and-Pop Suppression

The 500Ω shunt resistors on the MAX14535E/MAX14537E/MAX14539E automatically discharge any capacitance at the NO_ terminals (or NC_ terminals, MAX14539E) when they are unconnected from COM_. This reduces audio click-and-pop sounds that may occur when switching between capacitively coupled audio sources.

Applications Information

Extended ESD Protection

ESD protection structures are incorporated on all pins to protect against electrostatic discharges up to ±2kV (HBM) encountered during handling and assembly. COM1 and COM2 are further protected against ESD up to ±15kV (HBM) without damage. The ESD structures withstand high ESD both in normal operation and when the device is powered down. After an ESD event, the MAX14535E–MAX14539E continue to function without latchup.

ESD Test Conditions

ESD performance depends on a variety of conditions. Contact Maxim for a reliability report that documents test setup, test methodology, and test results.

Human Body Model

Figure 3a shows the Human Body Model. Figure 3b shows the current waveform it generates when discharged into a low impedance. This model consists of a 100pF capacitor charged to the ESD voltage of interest that is then discharged into the device through a 1.5kΩ resistor.

IEC 61000-4-2

The main difference between tests done using the Human Body Model and IEC 61000-4-2 is higher peak current in the IEC 61000-4-2. Because series resistance is lower in the IEC 61000-4-2 ESD test model (Figure 3c) the ESD withstand voltage measured using the Human Body Model. Figure 3d shows the current waveform for the ±8kV IEC 61000-4-2 Level 4 ESD Contact Discharge test.

The Air-Gap Discharge test involves approaching the device with a charged probe. The Contact Discharge method connects the probe to the device before the probe is energized.

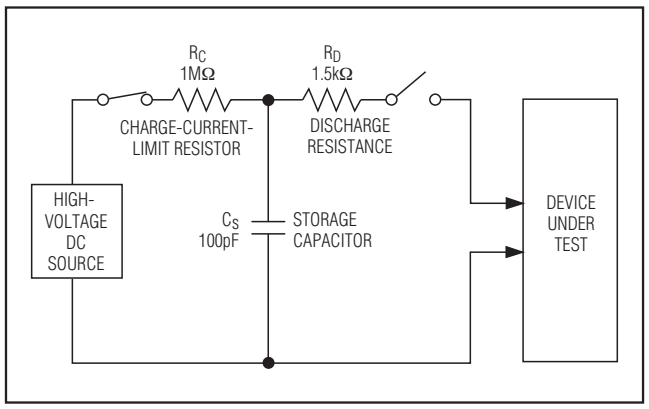


Figure 3a. Human Body ESD Test Model

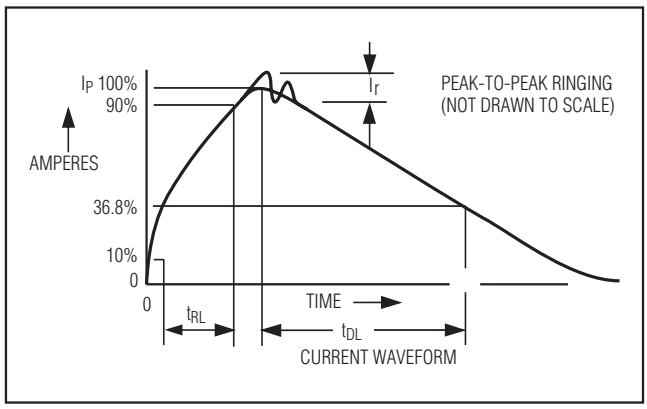


Figure 3b. Human Body Current Waveform

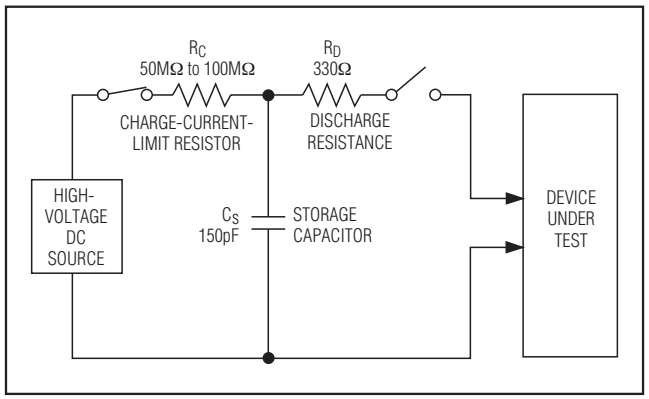


Figure 3c. IEC 61000-4-2 ESD Test Model

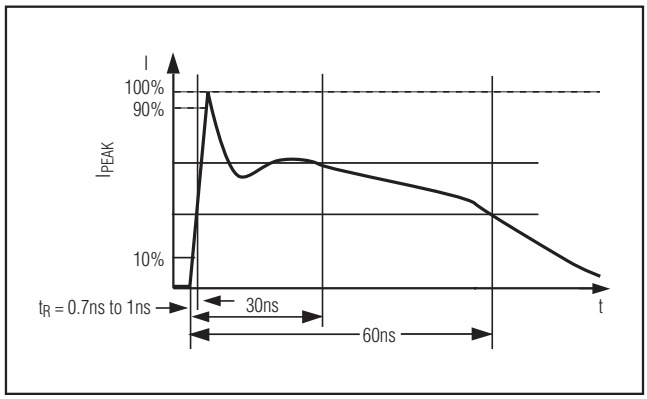


Figure 3d. IEC 61000-4-2 ESD Generator Current Waveform

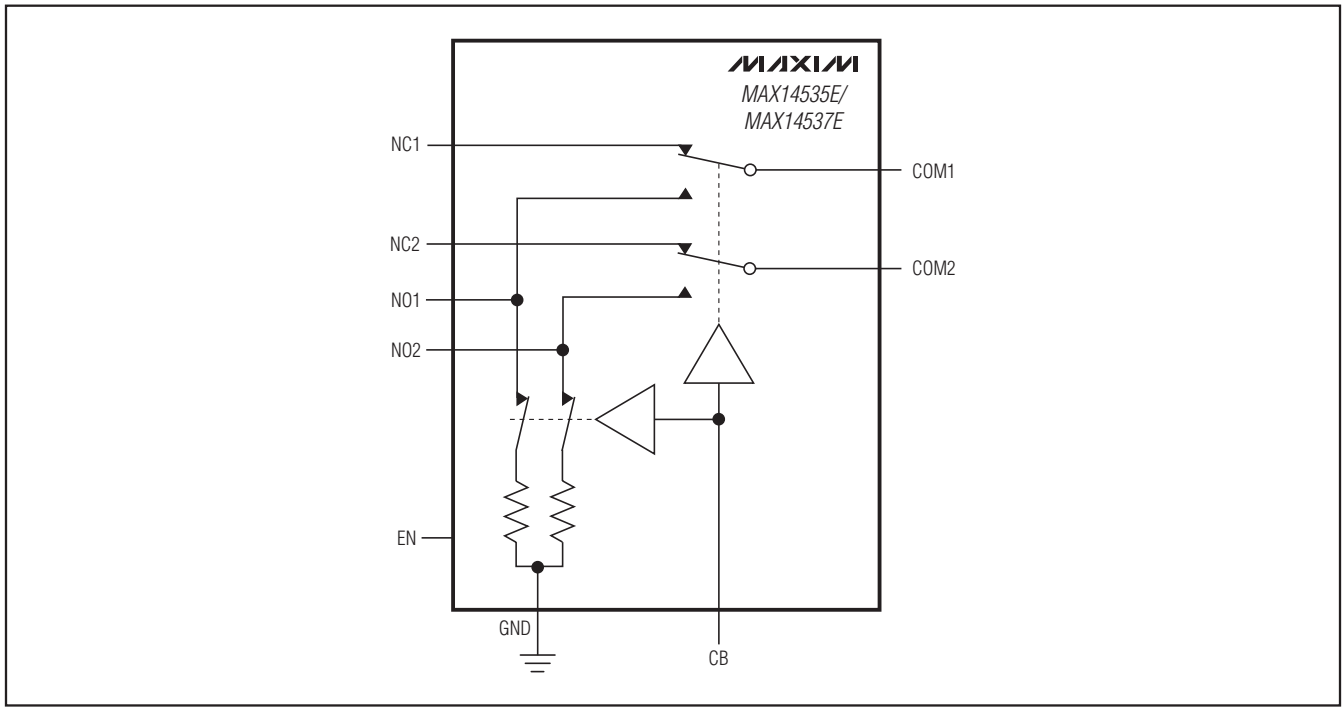
Low-Resistance DPDT Switches with Negative Rail

Power-Supply Sequencing

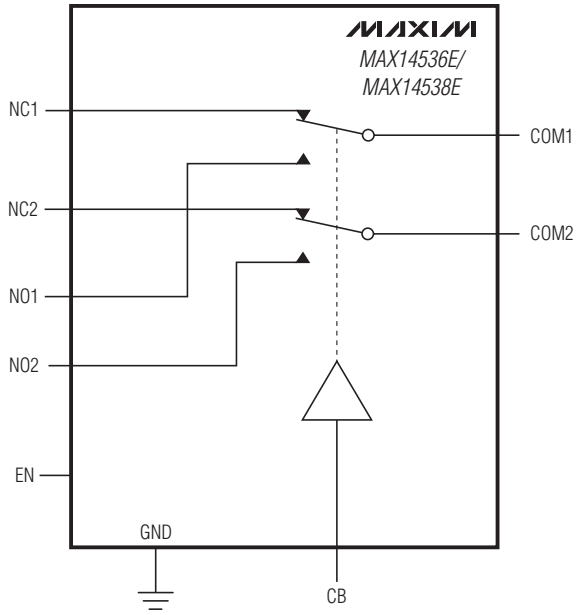
Caution: Do not exceed the absolute maximum ratings because stresses beyond the listed ratings may cause permanent damage to the device.

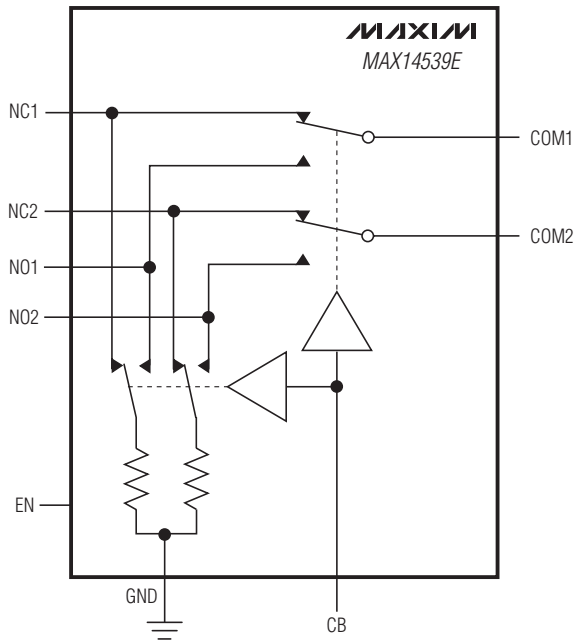
Proper power-supply sequencing is recommended for all devices. Apply V_{CC} before applying analog signals, especially if the analog signal is not current limited.

Functional Diagrams



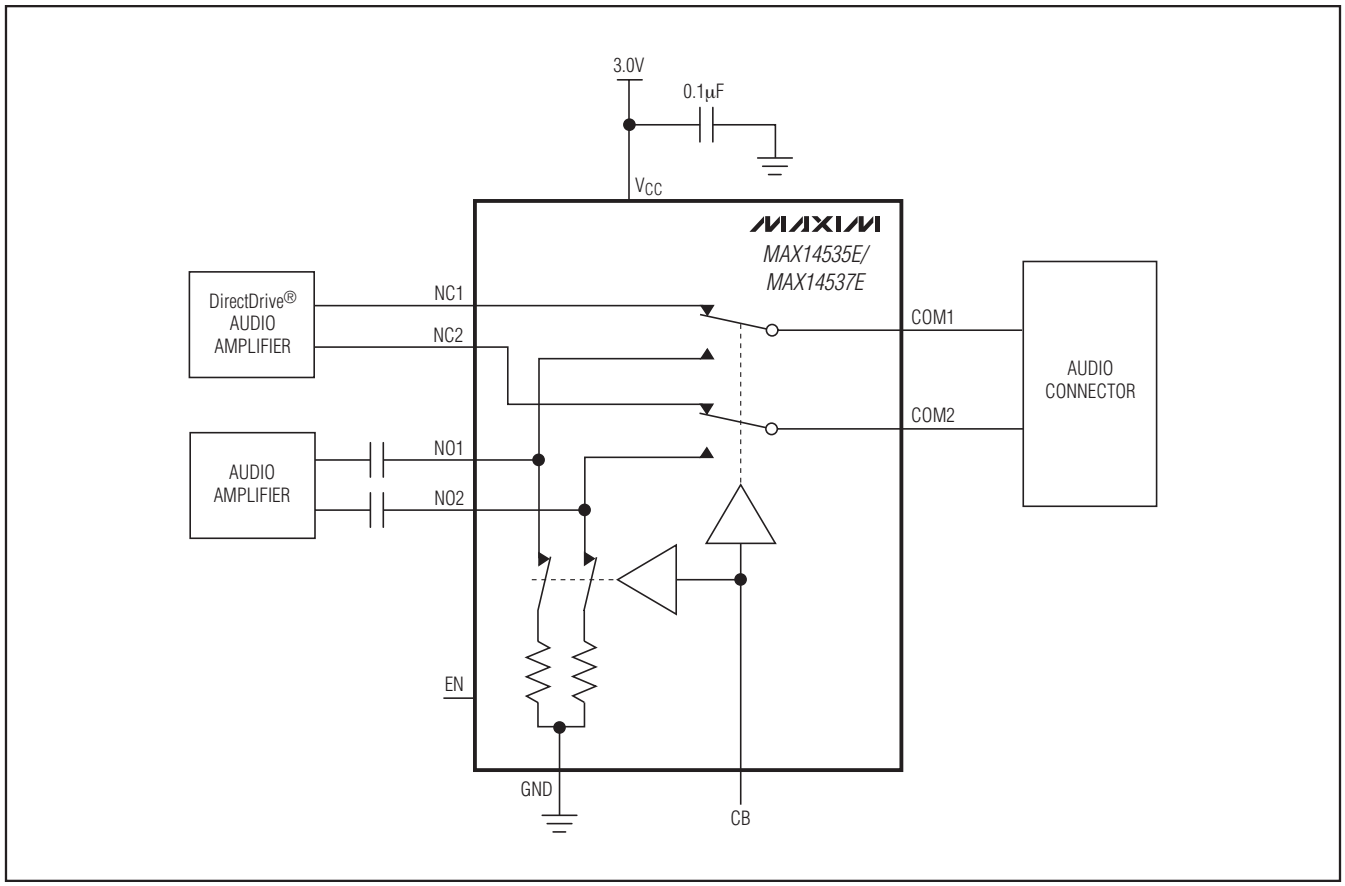
Functional Diagrams (continued)





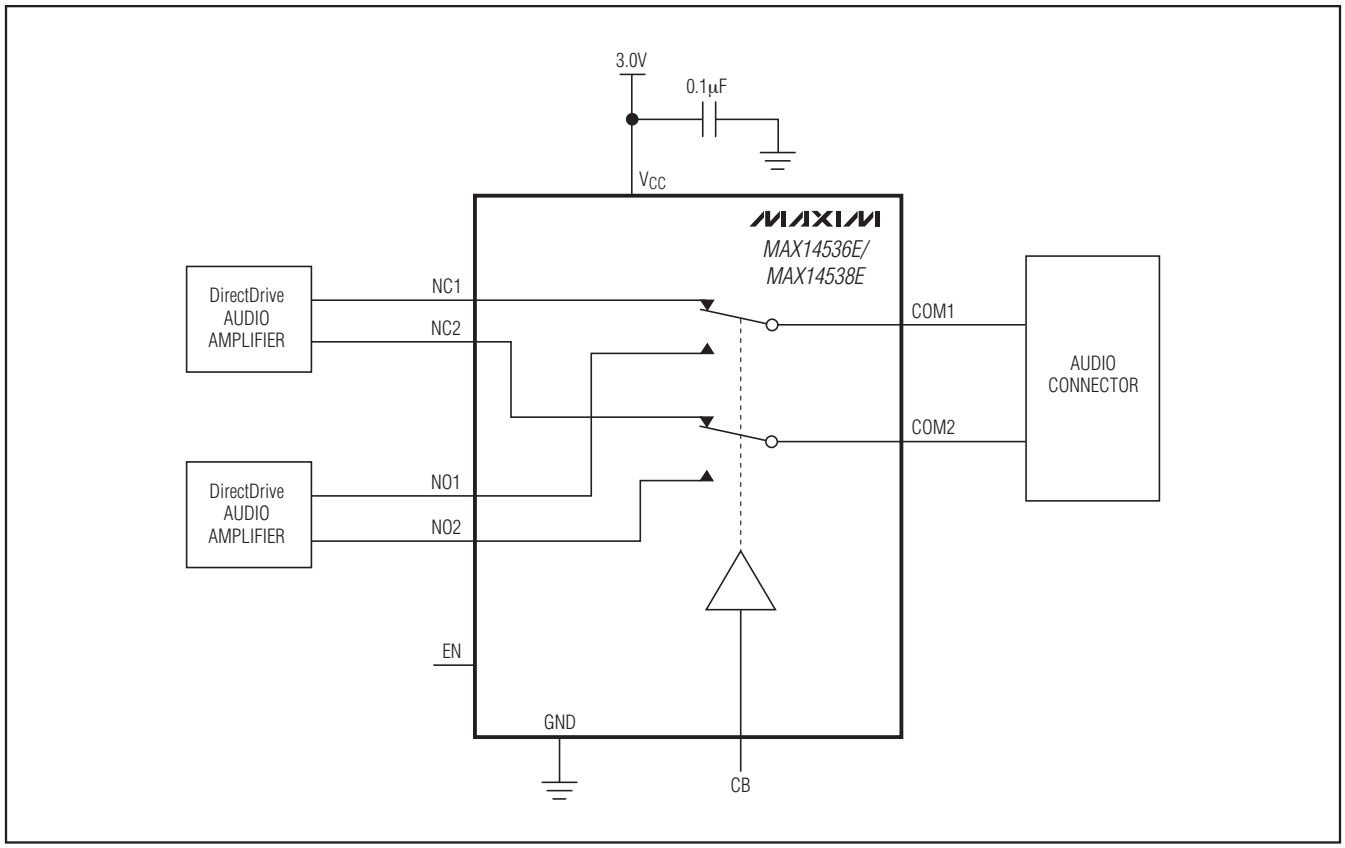
Low-Resistance DPDT Switches with Negative Rail

Typical Operating Circuits



DirectDrive is a registered trademark of Maxim Integrated Products, Inc.

Typical Operating Circuits (continued)



Chip Information

PROCESS: BiCMOS

Package Information

For the latest package outline information and land patterns, go to **www.maxim-ic.com/packages**.

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.
10 UTQFN	V101A1CN+1	**21-0028**

Low-Resistance DPDT Switches with Negative Rail

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/09	Initial release	—
1	4/09	Removed future product asterisk for MAX14536E and updated *Electrical Characteristics* table.	1

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