



# MAX1645A Evaluation Kit/Evaluation System

## General Description

The MAX1645A evaluation system (EV system) consists of a MAX1645A evaluation kit (EV kit) and a companion Maxim System Management Bus (SMBus™) interface board. The EV kit simplifies evaluation of the MAX1645A chemistry-independent Level 2 smart battery charger.

The Maxim SMBus interface board (MAXSMBus) allows an IBM-compatible personal computer to use its parallel port to emulate an Intel SMBus 2-wire interface. Windows 95/98® software provides a user-friendly interface to exercise the MAX1645A's features.

Order the MAX1645AEVSYS for complete IBM PC-based evaluation of the MAX1645A. Order the MAX1645AEVKIT if you already have an SMBus interface.

## EV System

DESIGNATION	QTY	DESCRIPTION
None	1	MAX1645A EV kit
None	1	MAXSMBus interface

## Features

- ◆ Charges Any Battery Chemistry: Li+, NiCd, NiMH, Lead Acid, etc.
- ◆ SMBus-Compatible 2-Wire Serial Interface
- ◆ 3A (max) Battery Charge Current
- ◆ Up to 18.4V Battery Voltage
- ◆ Up to +28V Input Voltage
- ◆ Easy-to-Use Software Included
- ◆ Proven PC Board Layout
- ◆ Fully Assembled and Tested Surface-Mount Board

## Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX1645AEVKIT	0°C to +70°C	28 QSOP
MAX1645AEVSYS	0°C to +70°C	28 QSOP

## EV Kit Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	22µF, 35V low-ESR tantalum caps AVX TPSE226M035R0300
C3, C4	2	22µF, 25V low-ESR tantalum caps AVX TPSD226M025R0200
C5, C19, C20	3	1µF, 50V ceramic capacitors (1210) Murata GRM42-2X7R105K050
C6, C7, C12	3	1µF, 10V ceramic capacitors (0805) Taiyo Yuden LMK212BJ105MG
C8, C14, C15, C16	4	0.1µF, 16V ceramic capacitors (0603) Taiyo Yuden EMK107BJ104MA
C9, C10, C11	3	0.01µF ceramic capacitors (0603)
C13	1	1500pF ceramic capacitor (0603)
C18, C23, C24	3	0.1µF, 50V ceramic capacitors (0805) Taiyo Yuden UMK212BJ104MG
D1, D2	2	40V, 2A Schottky diodes Central Semiconductor CSMH2-40
D3, D4	2	Schottky diodes (SOT23) Central Semiconductor CMPSH-3

DESIGNATION	QTY	DESCRIPTION
H1	1	2x10 right-angle female header
H2	1	5-element terminal block
JU1, JU2, JU3	3	2-pin headers
L1	1	22µH, 3.6A inductor Sumida CDRH127-220
LED1	1	Red LED
N1	1	30V, 11.5A N-channel MOSFET Fairchild FDS6680
N2	1	30V, 8.4A N-channel MOSFET Fairchild FDS6612A
P1, P2	2	30V, 11A P-channel MOSFETs Fairchild FDS6675
R1	1	0.040Ω ±1%, 0.5W resistor Dale WSL-2010/0.040Ω/1%
R2	1	0.050Ω ±1%, 0.5W resistor Dale WSL-2010/0.050Ω/1%
R3, R4	2	100kΩ ±1% resistors (0603)
R5, R7, R9, R10, R17	5	10kΩ ±5% resistors (0603)
R6	1	10kΩ ±1% resistor (0603)

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Windows 95/98 are registered trademarks of Microsoft Corp.



**For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).**

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## EV Kit Component List (cont.)

DESIGNATION	QTY	DESCRIPTION
R8, R13	2	1k $\Omega$ $\pm$ 5% resistors (0603)
R11, R16	2	1 $\Omega$ $\pm$ 5% resistors (0603)
R12	1	33 $\Omega$ $\pm$ 5% resistor (0603)
R14, R15	2	4.7 $\Omega$ $\pm$ 5% resistors (0603)
U1	1	MAX1645AEEI (28-pin QSOP)
None	3	Shunts (JU1, JU2, JU3)
None	1	MAX1645A PC board
None	1	MAX1645A data sheet
None	1	MAX1645A EV kit data sheet
None	1	MAX1645A EV kit software disk

## Component Suppliers

SUPPLIER	PHONE	FAX
AVX	803-946-0690	803-626-3123
Central Semiconductor	516-435-1110	516-435-1824
Dale	402-564-3131	402-563-6418
Fairchild	408-822-2000	408-822-2102
Murata	814-237-1431	814-238-0490
Sumida	847-956-0666	847-956-0702
Taiyo Yuden	408-573-4150	408-573-4159

**Note:** Please indicate that you are using the MAX1645A when contacting the above component suppliers.

## Quick Start

### Required Equipment

Before you begin, you will need the following equipment:

- IBM PC-compatible computer capable of running Windows 95/98
- Parallel printer port (this is a 25-pin socket on the back of the computer)
- Standard 25-pin, straight-through, male-to-female cable to connect the computer's parallel port to the Maxim SMBus interface board
- DC power supply capable of supplying +20V to +28V at 3A

Table 1. Jumper Functions

JUMPER	STATE	FUNCTION
JU1	Closed*	SCL pulled up to V <sub>DD</sub> through a 10k $\Omega$ resistor.
	Open	SCL not pulled up to V <sub>DD</sub> ; SCL must be pulled up to external supply.
JU2	Closed*	SDA pulled up to V <sub>DD</sub> through a 10k $\Omega$ resistor.
	Open	SDA not pulled up to V <sub>DD</sub> ; SDA must be pulled up to external supply.
JU3	Closed*	10k $\Omega$ resistor connected between thermistor and ground nodes, simulating the attachment of a smart battery.
	Open	10k $\Omega$ resistor disconnected; for use when an actual smart battery will be connected to the EV kit.

\*Indicates default jumper setting

### Procedure

See Figure 1 as you follow these steps:

- 1) Carefully connect the boards by aligning the 20-pin connector of the MAX1645A EV kit with the 20-pin header of the MAXSMBus interface board. Gently press them together. The two boards should be flush against each other.
- 2) Verify that jumpers JU1, JU2, and JU3 are all shunted. JU1 and JU2 pull up the SMBus clock and data lines to the V<sub>DD</sub> supply. JU3 connects a 10k $\Omega$  resistor between the ground and thermistor nodes, making it appear to the MAX1645A as if a smart battery were connected. Table 1 describes the jumper functions.

**Caution:** Do not turn on the power until all connections are made.

- 3) Connect a +20VDC to +28VDC power supply between the VIN pad and the adjacent GND pad on the MAX1645A EV kit board.
- 4) Connect a cable from the computer's parallel port to the SMBus interface board. Use a straight-through, 25-pin, female-to-male cable. To avoid damaging the EV kit or your computer, do not use a 25-pin SCSI port or any other connector that is physically similar to the 25-pin parallel printer port.

**Note:** Do not connect a power supply to the MAXSMBus board. Power is supplied through the MAX1645A EV kit board.

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Evaluate: MAX1645A

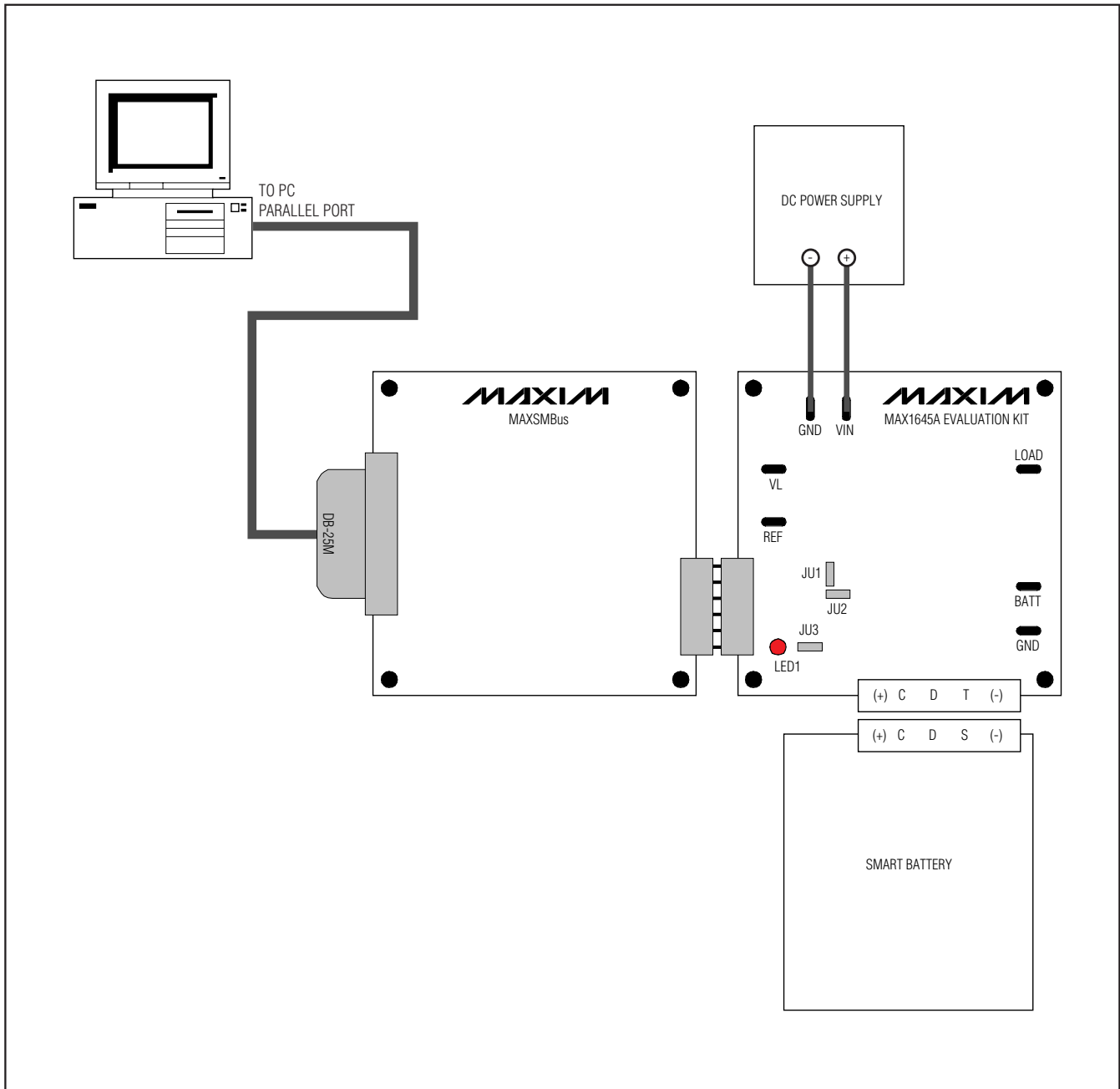


Figure 1. Block Diagram of MAX1645A EV System

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- 5) Install the MAX1645A EV kit software on your computer by running the *INSTALL.EXE* program on the floppy disk. This program copies the MAX1645A program file and creates an icon for it.
- 6) Turn on the power supply. Verify that LED1 turns on.
- 7) Start the MAX1645A program by opening its icon in the START MENU. The EV kit software automatically detects the correct port by testing for the pin 5 to pin 13 loopback. Verify that LED1 turns off, signifying that communication between the PC and the MAX1645A has been established.
- 8) The software should appear as shown in Figure 2. Verify that Charging Voltage = 65535mV, Charging Current = 128mA; HOT\_STOP is checked; Voltage Polling, Current Polling, and Status Polling are checked; and the following checkboxes are checked in the Charger Status panel: VOLTAGE\_NOTREG, VOLTAGE\_OR, BATTERY\_PRESENT, and AC\_PRESENT.

## Detailed Description of Software

Upon execution of the MAX1645A program, the software automatically resolves the SMBus address of the

device. The software enables the command panel (Figure 2), after which the user may issue any of the allowed SMBus commands to the MAX1645A. (Refer to the MAX1645A data sheet for more information regarding the allowed SMBus commands.)

### Command Panel

#### ChargingVoltage()

To issue the ChargingVoltage() command to the MAX1645A, enter the desired voltage, in millivolts, into the Charging Voltage text edit box and select the adjacent [Send] button. By default, the software issues the ChargingVoltage() command three times a second. To enable/disable this feature, check/uncheck the Voltage Polling checkbox. If a smart battery is connected to the charger, the Charging Voltage value displayed will be identical to the value being broadcast by the smart battery.

#### ChargingCurrent()

To issue the ChargingCurrent() command to the MAX1645A, enter the desired current, in milliamps, into the Charging Current text edit box and select the adjacent [Send] button. By default, the software issues the ChargingCurrent() command three times a second. To

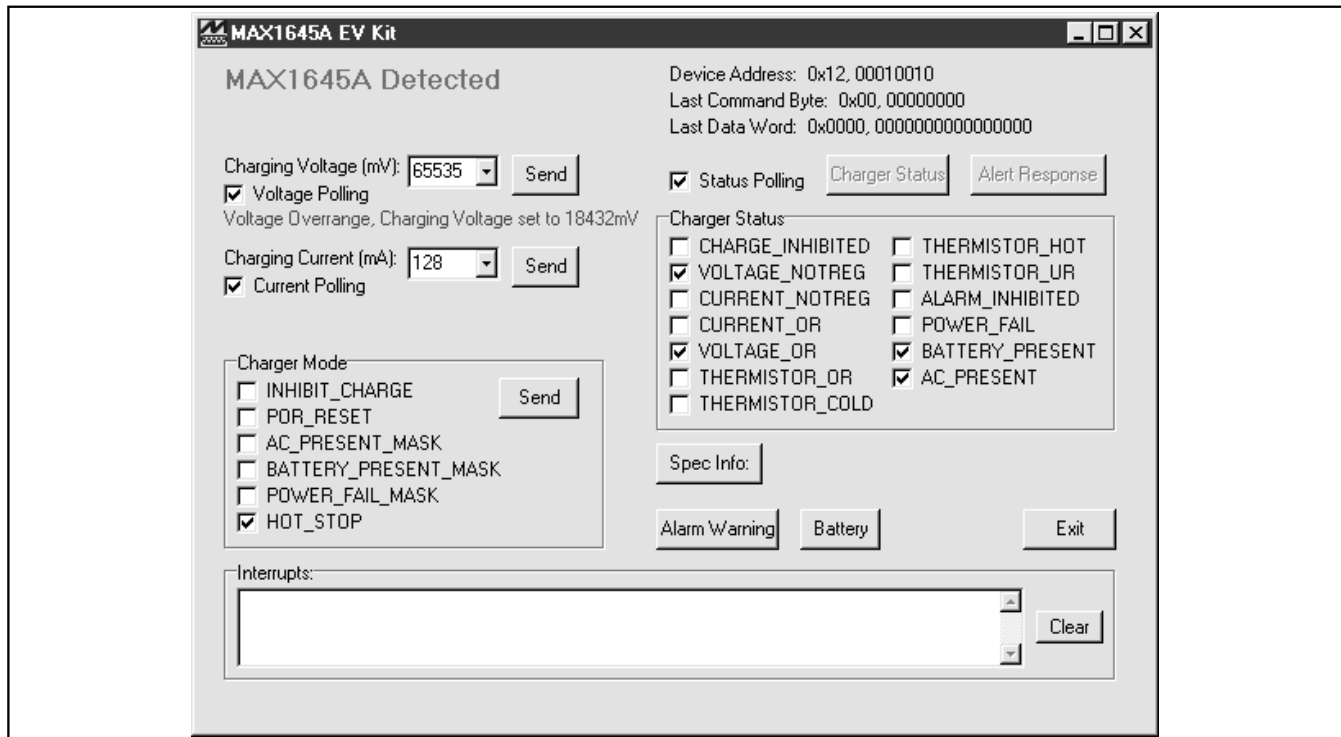


Figure 2. MAX1645A EV Kit Software Command Panel

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enable/disable this feature, check/uncheck the Current Polling checkbox. If a smart battery is connected to the charger, the Charging Current value displayed will be identical to the value being broadcast by the smart battery.

Note that when either Voltage Polling or Current Polling are checked, the action of issuing the ChargingVoltage() or ChargingCurrent() commands automatically services the watchdog timer. If both of these checkboxes are unchecked, the watchdog timer will eventually time out and charging will stop. For more information about the watchdog timer, refer to the MAX1645A data sheet. If the watchdog timer period of 175s is exceeded, reset the watchdog timer by issuing *both* the ChargingVoltage() and ChargingCurrent() commands.

## ChargerMode()

To issue the ChargerMode() command to the MAX1645A, select a combination of checkboxes in the Charger Mode panel of commands. Check the checkboxes next to commands for which the software should write a 1, uncheck the checkboxes next to commands for which the software should write a 0, and then select the [Send] button.

## ChargerStatus()

On the right-hand side of the command panel, locate the Status Polling checkbox and the Charger Status panel. If the Status Polling checkbox is checked (the default setting), the software automatically issues the ChargerStatus() command three times a second, in which case the checkboxes in the Charger Status panel are automatically updated and always represent the charger's current status. Unchecking the Status Polling checkbox disables automatic software polling. If polling is disabled, the user can issue the ChargerStatus() command to the MAX1645A by selecting the [Charger Status] button, which is adjacent to the Status Polling checkbox.

## AlertResponse()

The MAX1645A has an external interrupt pin that is polled by the software if the Status Polling checkbox is checked. When an interrupt occurs, LED1 on the EV kit board illuminates. If polling is enabled, the software determines which event triggered the interrupt, clears the interrupt, and prints a diagnostic message in the Interrupts box. If polling is disabled and an interrupt occurs, the user can manually service the interrupt by selecting the [Alert Response] button.

The Alert Response operation works as follows: the SMBus specification revision 1.0 describes an optional wired-or signal called SMBALERT that, in a typical system, is connected to all the devices and then pulled up to V<sub>DD</sub>. A SLAVE device can use this signal to notify the bus MASTER that it wants to communicate. It does this by pulling the SMBALERT line LOW. When the MASTER sees the SMBALERT line go LOW, it knows that one of the SLAVE devices wants attention, but not which one. To determine which SLAVE pulled the SMBALERT line LOW, the MASTER broadcasts the Alert Response Address (0x18) to all of the SLAVE devices on the bus using a modified RECEIVE BYTE operation. The SLAVE device wanting to communicate with the MASTER responds with its SMBus address (0x13) during the second byte of the modified RECEIVE BYTE operation.

## AlarmWarning()

To issue the AlarmWarning() command to the MAX1645A, select the [Alarm Warning] button. This operation sends the AlarmWarning() command byte with a data word of 0x8000.

## ChargerSpecInfo()

To issue the ChargerSpecInfo() command to the MAX1645A, select the [Spec Info] button. The response of the MAX1645A is displayed to the right of the [Spec Info] button.

## Communication with a Smart Battery

If a smart battery is connected to the MAX1645A EV kit, the user may observe the status of the smart battery by selecting the [Battery] button. At this point, the smart battery window appears (Figure 3). If software polling of the charger's status is enabled, the software also

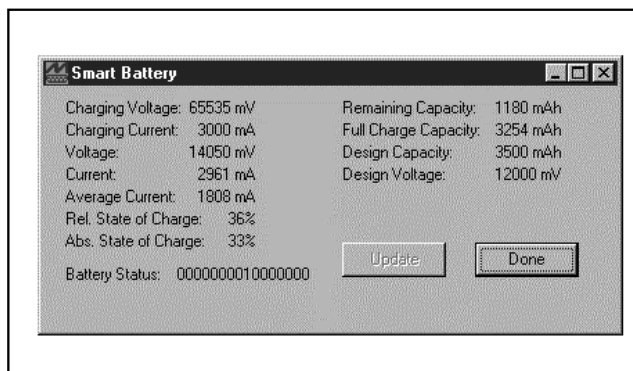


Figure 3. MAX1645A EV Kit Smart Battery Window

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automatically polls the status of the smart battery, and the parameters displayed in the smart battery window always represent the current status of the smart battery. If polling is disabled, manually query the smart battery by selecting the [Update] button. When finished, select the [Done] button to return to the main MAX1645A user interface window.

## **Serial Communications Interface**

When the user issues a command, the MAX1645A software first determines the command byte, then, if the command is a Write-Word type, the data word corresponding to the selected function. The software and MAX1645A device communicate serially through the MAXSMBus board. Refer to the MAX1645A data sheet for more information regarding the serial communications protocol.

## **Detailed Description of Hardware**

### **Input Current Limiting**

The MAX1645A EV kit is configured to regulate the battery current so that the total  $V_{IN}$  input current does not exceed 2.5A. If a load is connected across the LOAD and GND pads (another system power supply, for example) that would cause the total current from  $V_{IN}$  to exceed 2.5A, the MAX1645A will automatically decrease its charging current to regulate the input current to 2.5A. Refer to the MAX1645A data sheet for more information regarding input current limiting.

### **Connecting a Smart Battery**

The MAX1645A EV kit includes a five-element terminal block to facilitate connecting the EV kit to a smart battery. Refer to the smart battery specification to identify the type of smart battery connector suited to your application. Make sure that the EV kit power is turned off, and connect the (+), C, D, T, and (-) terminals from the EV kit board to the smart battery connector using no more than 2 inches of wire. Remove the JU3 shunt, attach a smart battery to the smart battery connector, and turn the EV kit power back on. See Figure 1 if necessary.

### **Connecting an Electronic Load**

If a smart battery is unavailable, an electronic load can be connected across the BATT and GND pads on the MAX1645A EV kit board. Make sure that the EV kit power is turned off before connecting a load. Make sure that JU3 is shunted, making it appear to the MAX1645A as if a smart battery were connected. After the load is connected, program the load in voltage mode and set the electronic load to clamp at 5V. Turn on the power to the EV kit, and program the MAX1645A with a charging voltage of 12V at the maximum charging current. Verify that the MAX1645A is supplying the maximum current to the load. Increase the electronic load clamp voltage in 1V increments, and verify that as the electronic load voltage crosses 12V, the MAX1645A transitions from current regulation to voltage regulation; as the electronic load voltage increases beyond 12V, the BATT voltage should remain fixed at 12V.

### **Layout Considerations**

The MAX1645A EV kit layout is optimized for fast switching and high currents. The traces connecting the power components must be able to carry at least 3A. Take care to ensure that C1 and C2 (the input capacitors), D2 and N2 (the synchronous rectifier), and C3 and C4 (the output capacitors) are all connected to GND at a common point, and to isolate the power GND from the quiet analog GND.

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Evaluate: MAX1645A

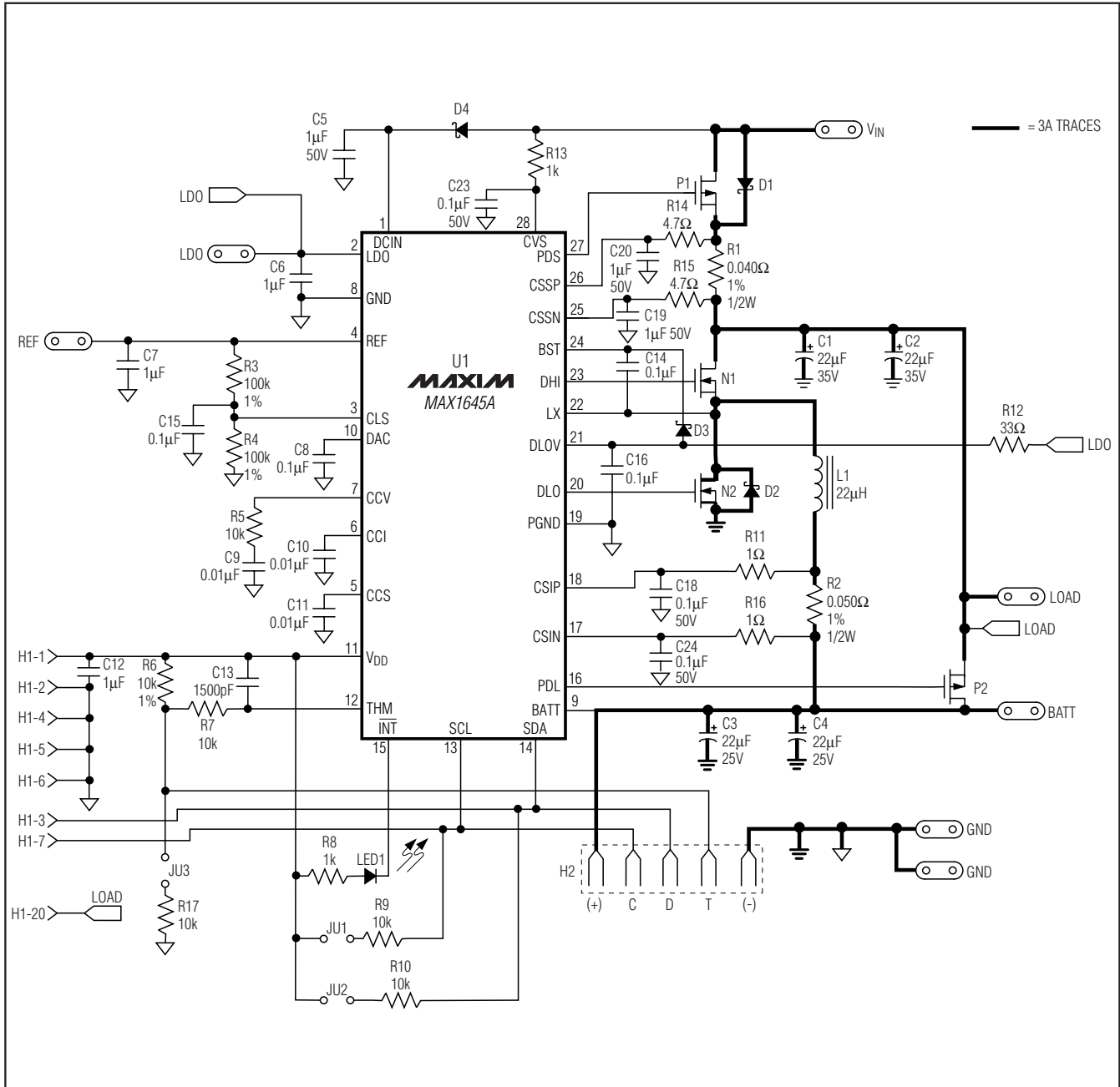


Figure 4. MAX1645A EV Kit Schematic

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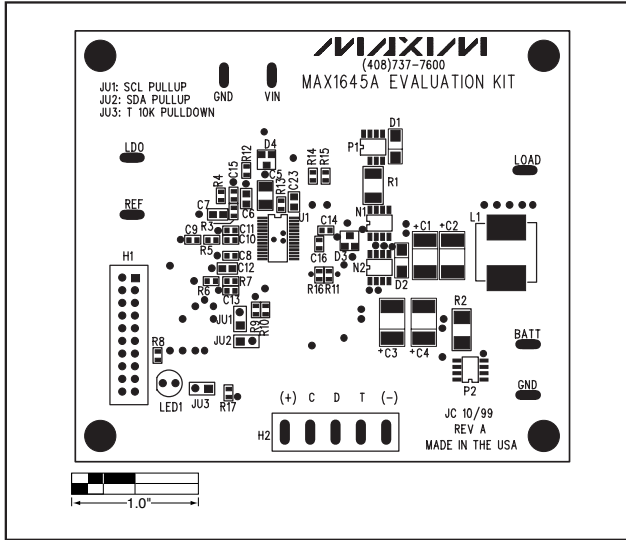


Figure 5. MAX1645A EV Kit Component Placement Guide—Component Side

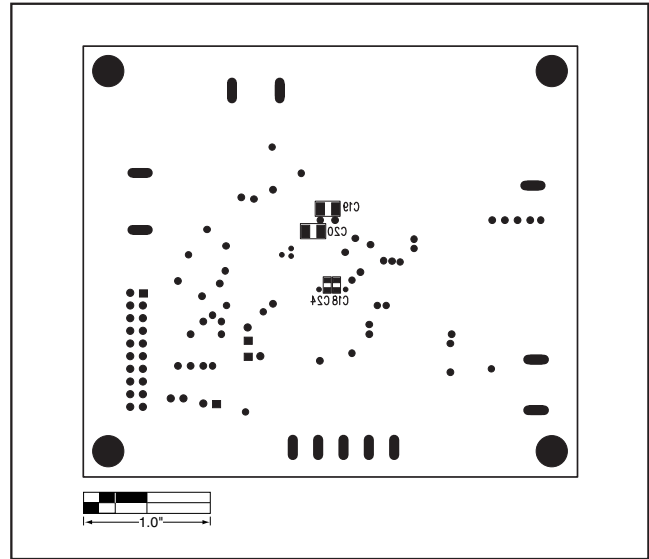


Figure 6. MAX1645A EV Kit Component Placement Guide—Solder Side

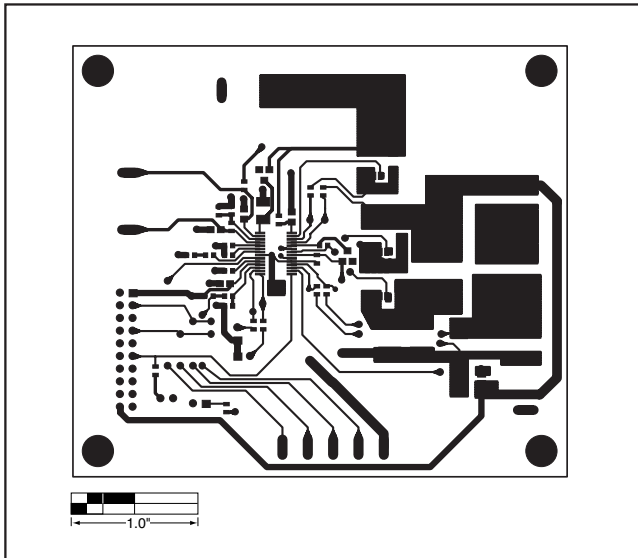


Figure 7. MAX1645A EV Kit PC Board Layout—Component Side

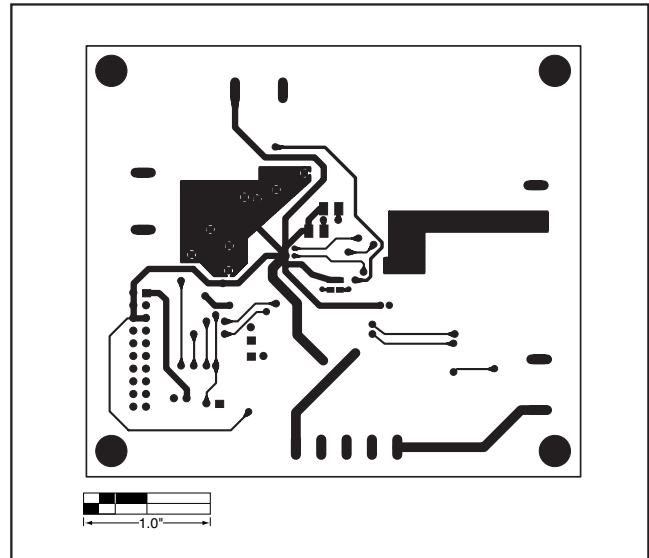


Figure 8. MAX1645A EV Kit PC Board Layout—Solder Side

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