MAXIM

MAX17535 Evaluation Kit

Evaluates: MAX17535

General Description

The MAX17535 evaluation kit (EV kit) is an assembled and tested PCB that evaluates the MAX17535 IC. The IC is a multichemistry battery charger controller with SMBus™-programmable charge current, charge voltage, input-current limit, relearn voltage, and digital readback of the IINP voltage. The EV kit is capable of supplying power to a system load while simultaneously charging multichemistry battery packs. During operation, the EV kit circuit automatically selects the AC adapter input or the battery as the main power source for supplying power to the system load. Whenever the EV kit current limit is exceeded, the battery-charge current is reduced automatically to give priority to the system load.

The EV kit's input-current limit, battery-charge voltage, and maximum battery-charge current can be programmed through the SMBus-compatible serial interface, communicating at data rates up to 100kbps. The SMBus data is sent through an on-board USB interface circuit using a PC or a user-supplied SMBus controller.

The EV kit also features Windows® 2000-, Windows XP®-, and Windows Vista®-compatible software that provides a user interface for exercising the IC's features. The program is menu driven and offers a graphical user interface (GUI) complete with buttons and checkboxes.

Features

♦ **8V to 24V Input Operation**
♦ **Software Controlled**
    Input Source Current Up to 11A
    Charge Current Up to 7A
    Charge Voltage Up to 19.2V
    Relearn Voltage Up to 19.2V
    IINP Voltage Readback
♦ **Monitor Outputs for**
    AC Adapter Current/Battery Discharge Current
    AC Adapter Presence
♦ **5.4V Linear Regulator Output**
♦ **Automatic Power-Source Selection**
♦ **Proven PCB Layout**
♦ **On-Board USB Interface Circuit Generates SMBus-Compatible Signals**
♦ **USB-PC Connection (Cable Included)**
♦ **PCB Pads for User-Supplied SMBus-Compatible Signals**
♦ **Evaluates the MAX17535ETG+ in 24-Pin TQFN Package with Exposed Pad**
♦ **Windows 2000-, Windows XP-, and Windows Vista (32-Bit)-Compatible Software**
♦ **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX17535EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
ADAPTER, BATT, PGND (x3), SYSLD	6	Uninsulated banana jack panel-mount connectors
C1, C3–C10, C17, C32, C33	12	0.1µF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C104K or TDK C1608X7R1C104K

DESIGNATION	QTY	DESCRIPTION
C2, C13, C15	3	10µF ±20%, 6.3V X5R ceramic capacitors (0805) Murata GRM21BR60J106M or TDK C2012X5R0J106M
C11, C12	2	10pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H100J or TDK C1608C0G1H100J

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Windows, Windows XP, and Windows Vista are registered trademarks of Microsoft Corp.

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C14, C16, C22, C28, C29, C30, C37	7	1µF ±10%, 35V X5R ceramic capacitors (0603) Taiyo Yuden GMK107BJ105KA
C18, C19	2	22pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J or TDK C1608C0G1H220J
C20	1	3300pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H332K or TDK C1608X7R1H332K
C21	0	Not installed, ceramic capacitor (0805)
C23, C27	0	Not installed, ceramic capacitors (1210)
C24, C25	2	4.7µF ±20%, 25V X5R ceramic capacitors (1206) Murata GRM31CR61E475MA88 or TDK C3216X5R1E475M
C26	1	10µF ±10%, 25V X5R ceramic capacitor (1206) Murata GRM31CR61E106K
C31	1	0.018µF ±10%, 16V X7R ceramic capacitor (0603) Murata GRM188R71C183K
C34	1	0.01µF ±10%, 25V X7R ceramic capacitor (0603) Murata GRM188R71E103K or TDK C1608X7R1E103K
C35	1	1000pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H102K TDK C1608X7R1H102K
C36	0	Not installed, ceramic capacitor (0603)
D1	1	Green LED (0603)
D2	1	80V, 250mA switching diode (SOD523) Diodes Inc. 1N4148WT
JU1, JU2, JU3	3	2-pin headers
JU4, JU5	2	3-pin headers

DESIGNATION	QTY	DESCRIPTION
L1	1	4.3µH, 11A inductor Sumida CEP125NP-4R3MC-U
N1, N2	2	30V, 13A n-channel MOSFETs (8 SO) Fairchild FDS6670A
N3	1	30V, 8.5A n-channel MOSFET (8 SO) Fairchild FDS8884
N4	1	30V, 10A n-channel MOSFET with Schottky (8 SO) Fairchild FDS6690AS
N5	1	60V, 115mA n-channel MOSFET (SOT23) Diodes Inc. 2N7002-7-F (Top Mark: 702)
P1	1	30V, 8.8A p-channel MOSFET (8 SO) Fairchild FDS4435BZ
R1, R8, R11, R19, R20, R27, R28, R29	0	Not installed, resistors (0603) R1, R8, R27 are PCB shorts; R11, R19, R20, R28, R29 are open
R2	1	220Ω ±5% resistor (0603)
R3, R15, R26	3	10kΩ ±5% resistors (0603)
R4	1	2.2kΩ ±5% resistor (0603)
R5	1	1.5kΩ ±5% resistor (0603)
R6, R7	2	27Ω ±5% resistors (0603)
R9, R10	2	4.7kΩ ±5% resistors (0603)
R12	1	150kΩ ±5% resistor (0603)
R13	1	102kΩ ±1% resistor (0603)
R14, R21	2	10kΩ ±1% resistors (0603)
R16	1	10mΩ ±1%, 2W sense resistor (2512) IRC LRC-LRF-2512LF-01-R010-F
R17	1	10mΩ ±1%, 1W sense resistor (2010) IRC LRC-LRF-2010LF-01-R010-F
R18, R31, R33, R34	4	10Ω ±5% resistors (0603)
R22	1	0Ω ±5% resistor (0603)
R23	1	49.9kΩ ±1% resistor (0603)
R24	1	7.15kΩ ±1% resistor (0603)
R25	1	10.2kΩ ±1% resistor (0603)
R30	1	1kΩ ±1% resistor (0603)
R32	1	5.1Ω ±5% resistor (0603)
TP1–TP5	5	Test points, red
USB	1	USB type-B right-angle female receptacle

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
U1	1	Battery charger with SMBus (24 TQFN-EP*) Maxim MAX17535ETG+
U2	1	32-bit microcontroller (68 QFN-EP*) Maxim MAXQ2000-RAX+
U3	1	93C46-type 3-wire EEPROM (8 SO)
U4	1	UART-to-USB converter (32 TQFP)
U5	1	3.3V regulator (5 SOT23) Maxim MAX8888EZK33+ (Top Mark: ADQC)

DESIGNATION	QTY	DESCRIPTION
U6	1	2.5V regulator (5 SC70) Maxim MAX8511EXK25+ (Top Mark: ADV)
Y1	1	16MHz crystal Hong Kong X'tals SSM16000N1HK188F0-0
Y2	1	6MHz crystal Hong Kong X'tals SSL60000N1HK188F0-0
—	5	Shunts
—	1	PCB: MAX17535 EVALUATION KIT+

*EP = Exposed pad.

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Diodes Incorporated	805-446-4800	www.diodes.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
IRC, Inc.	361-992-7900	www.irctt.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Sumida Corp.	847-545-6700	www.sumida.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 MAX17535 when contacting these component suppliers.

MAX17535 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV Kit files on the computer
MAX17535.EXE	Application program
FTD2XX.INF	USB driver file
UNINST.INI	Uninstalls the EV Kit software
USB_Driver_Help.PDF	USB driver installation help file

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Quick Start

Required Equipment

- MAX17535 EV kit (USB cable included)
- User-supplied Windows 2000, Windows XP, or Windows Vista PC with a spare USB port
- One 8V to 24V, 11A variable power supply
- One voltmeter

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. The test procedure assumes Windows XP SP2 is used. Similar steps are required for the other supported operating systems.

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all connections are completed.**

1) Visit **www.maxim-ic.com/evkitsoftware** to download the latest version of the EV kit software, 17535Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.

2) Install the EV kit software on the computer by running the INSTALL.EXE program inside the temporary folder. The program files are copied and icons are created in the Windows **Start | Programs** menu.

3) Verify that a shunt is installed on jumpers JU1 and JU2. This configures the SMBus input pins to receive signals from the USB interface circuit.

4) Verify that a shunt is installed on jumper JU3 (IC charger enabled).

5) Verify that a shunt is connected to pins 2-3 of jumper JU4 (AC adapter current limit and/or battery-discharge current limit set to 3.4A).

6) Verify that a shunt is connected to pins 2-3 of jumper JU5 (DCIN can be powered from the AC adapter or the battery).

7) Connect the power supply across the ADAPTER and PGND banana jack connectors.

8) Turn on the power supply and set the supply voltage to 20V.

9) Connect the USB cable from the PC to the EV kit board. A **New Hardware Found** window pops up when installing the USB driver for the first time. If a window is not seen that is similar to the one described above after 30s, remove the USB cable from the board and reconnect it. Administrator privileges are required to install the USB device driver on Windows.

10) Follow the directions of the **Add New Hardware Wizard** to install the USB device driver. Choose the **Search for the best driver for your device** option. Specify the location of the device driver to be **C:\Program Files\MAX17535** (default installation directory) using the **Browse** button. During device driver installation, Windows may show a warning message indicating that the device driver Maxim uses does not contain a digital signature. This is not an error condition and it is safe to proceed with installation. Refer to the USB_Driver_Help.PDF document included with the software for additional information.

11) Start the EV kit software by opening its icon in the **Start | Programs** menu.

12) Observe as the program automatically detects the connection of the device and starts the main program. After successful connection, the EV kit software main window appears in the upper-left corner of the window, as shown in Figure 1.

13) Check the **Adds 4096mA** checkbox and then press the **Write** button in the **0x3F Input Current** group box.

14) Check the **Adds 2048mA** checkbox and then press the **Write** button in the **0x14 Charging Current** group box.

15) Verify the following:

PARAMETER	MEASURED OUTPUT (V)
BATT	0
SYSLD	20
$\overline{ACOK}$	0
LDO	5.4
EN	5.4
ADAPTLIM	5.4
VAA	4.1

16) The EV kit is now ready for additional testing.

See the *Detailed Description of Software* section for more information on the software features.
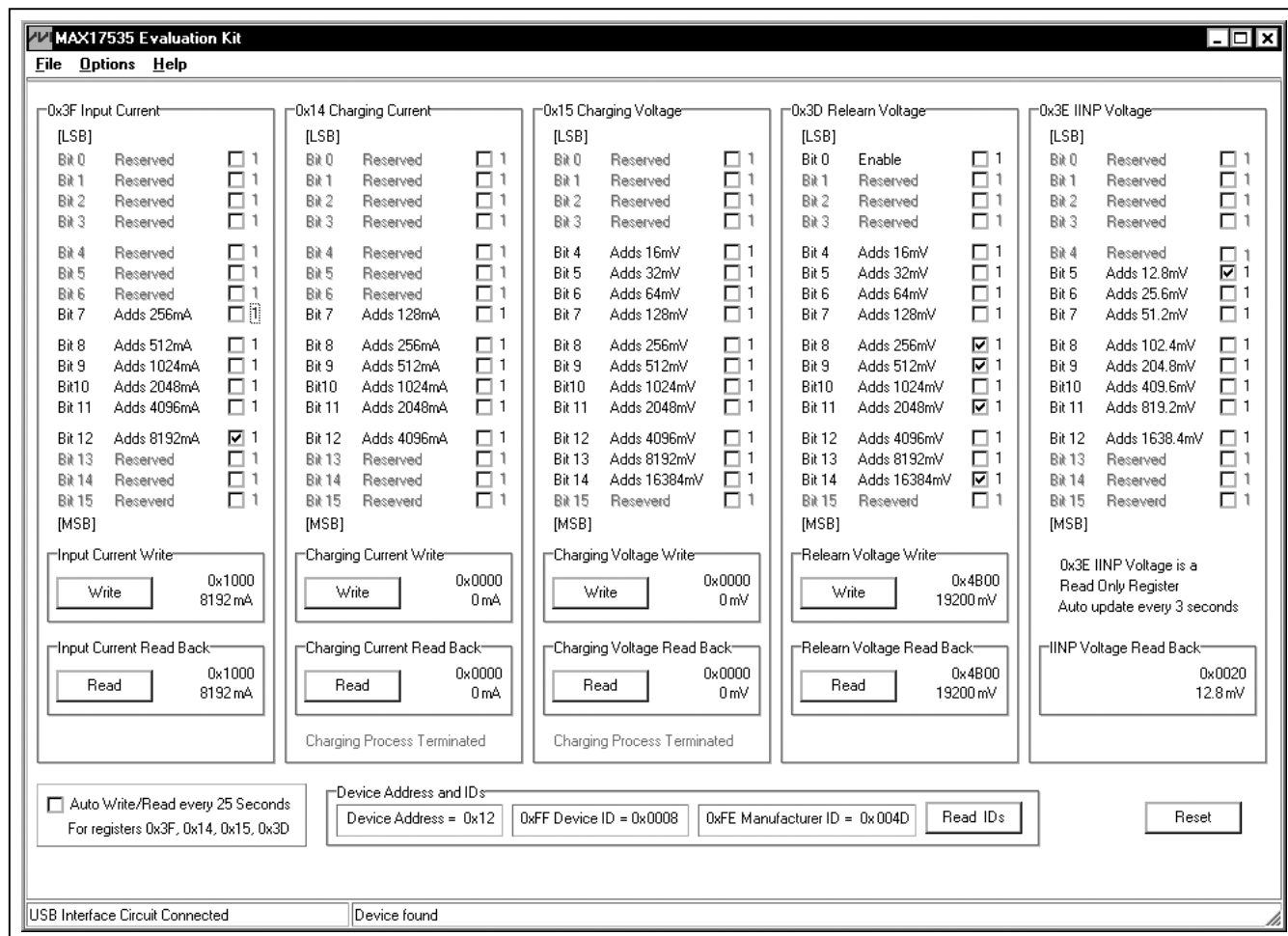
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File   Options   Help

0x3F Input Current

[LSB]

Bit 0	Reserved	☐ 1
Bit 1	Reserved	☐ 1
Bit 2	Reserved	☐ 1
Bit 3	Reserved	☐ 1
Bit 4	Reserved	☐ 1
Bit 5	Reserved	☐ 1
Bit 6	Reserved	☐ 1
Bit 7	Adds 256mA	☐ 1
Bit 8	Adds 512mA	☐ 1
Bit 9	Adds 1024mA	☐ 1
Bit10	Adds 2048mA	☐ 1
Bit 11	Adds 4096mA	☐ 1
Bit 12	Adds 8192mA	☑ 1
Bit 13	Reserved	☐ 1
Bit 14	Reserved	☐ 1
Bit 15	Reseverd	☐ 1

[MSB]

Input Current Write
Write   0x1000   8192 mA

Input Current Read Back
Read   0x1000   8192 mA

0x14 Charging Current

[LSB]

Bit 0	Reserved	☐ 1
Bit 1	Reserved	☐ 1
Bit 2	Reserved	☐ 1
Bit 3	Reserved	☐ 1
Bit 4	Reserved	☐ 1
Bit 5	Reserved	☐ 1
Bit 6	Reserved	☐ 1
Bit 7	Adds 128mA	☐ 1
Bit 8	Adds 256mA	☐ 1
Bit 9	Adds 512mA	☐ 1
Bit10	Adds 1024mA	☐ 1
Bit 11	Adds 2048mA	☐ 1
Bit 12	Adds 4096mA	☐ 1
Bit 13	Reserved	☐ 1
Bit 14	Reserved	☐ 1
Bit 15	Reseverd	☐ 1

[MSB]

Charging Current Write
Write   0x0000   0 mA

Charging Current Read Back
Read   0x0000   0 mA

Charging Process Terminated

0x15 Charging Voltage

[LSB]

Bit 0	Reserved	☐ 1
Bit 1	Reserved	☐ 1
Bit 2	Reserved	☐ 1
Bit 3	Reserved	☐ 1
Bit 4	Adds 16mV	☐ 1
Bit 5	Adds 32mV	☐ 1
Bit 6	Adds 64mV	☐ 1
Bit 7	Adds 128mV	☐ 1
Bit 8	Adds 256mV	☐ 1
Bit 9	Adds 512mV	☐ 1
Bit10	Adds 1024mV	☐ 1
Bit 11	Adds 2048mV	☐ 1
Bit 12	Adds 4096mV	☐ 1
Bit 13	Adds 8192mV	☐ 1
Bit 14	Adds 16384mV	☐ 1
Bit 15	Reseverd	☐ 1

[MSB]

Charging Voltage Write
Write   0x0000   0 mV

Charging Voltage Read Back
Read   0x0000   0 mV

Charging Process Terminated

0x3D Relearn Voltage

[LSB]

Bit 0	Enable	☐ 1
Bit 1	Reserved	☐ 1
Bit 2	Reserved	☐ 1
Bit 3	Reserved	☐ 1
Bit 4	Adds 16mV	☐ 1
Bit 5	Adds 32mV	☐ 1
Bit 6	Adds 64mV	☐ 1
Bit 7	Adds 128mV	☐ 1
Bit 8	Adds 256mV	☑ 1
Bit 9	Adds 512mV	☑ 1
Bit10	Adds 1024mV	☐ 1
Bit 11	Adds 2048mV	☑ 1
Bit 12	Adds 4096mV	☐ 1
Bit 13	Adds 8192mV	☐ 1
Bit 14	Adds 16384mV	☑ 1
Bit 15	Reseverd	☐ 1

[MSB]

Relearn Voltage Write
Write   0x4B00   19200 mV

Relearn Voltage Read Back
Read   0x4B00   19200 mV

0x3E IINP Voltage

[LSB]

Bit 0	Reserved	☐ 1
Bit 1	Reserved	☐ 1
Bit 2	Reserved	☐ 1
Bit 3	Reserved	☐ 1
Bit 4	Reserved	☐ 1
Bit 5	Adds 12.8mV	☑ 1
Bit 6	Adds 25.6mV	☐ 1
Bit 7	Adds 51.2mV	☐ 1
Bit 8	Adds 102.4mV	☐ 1
Bit 9	Adds 204.8mV	☐ 1
Bit10	Adds 409.6mV	☐ 1
Bit 11	Adds 819.2mV	☐ 1
Bit 12	Adds 1638.4mV	☐ 1
Bit 13	Reserved	☐ 1
Bit 14	Reserved	☐ 1
Bit 15	Reseverd	☐ 1

[MSB]

0x3E IINP Voltage is a
Read Only Register
Auto update every 3 seconds

IINP Voltage Read Back
0x0020   12.8 mV

☐ Auto Write/Read every 25 Seconds
For registers 0x3F, 0x14, 0x15, 0x3D

Device Address and IDs
Device Address = 0x12   0xFF Device ID = 0x0008   0xFE Manufacturer ID = 0x004D   Read IDs

Reset

USB Interface Circuit Connected   Device found

Figure 1. MAX17535 Evaluation Kit Software Main Window

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MAX17535 Evaluation Kit

__Detailed Description of Software

Note: Text in bold refers to user-selectable features in the MAX17535 EV kit software.

Graphical User Interface (GUI) Panel

The GUI shown in Figure 1 is the main window of the EV kit software that provides a convenient means to control the MAX17535 IC. Use the mouse or press the tab key to navigate through the GUI controls. The correct SMBus write operation is generated to update the IC's internal memory registers when any of these controls are executed.

The EV kit software main window (Figure 1) divides the EV kit functions into logical group boxes. The **0x3F Input Current** group box sets and reads back the adapter input-current limit on the EV kit. The **0x14 Charging Current** group box sets and reads back the battery-charging current on the EV kit. The **0x15 Charging Voltage** group box sets and reads back the battery-charging voltage on the EV kit. The **0x3D Relearn Voltage** group box enables/disables and sets and reads back the battery-relearn voltage on the EV kit. The **0x3E IINP Voltage** group box displays the input-current monitor output (IINP voltage) on the EV kit. The **Device Address and IDs** group box reads and displays the device address, device ID, and manufacturer ID of the IC. The **Auto Write/Read every 25 Seconds** checkbox automatically sends a write and read command every 25s to update and read back the data to and from registers 0x3F, 0x14, 0x15, and 0x3D. The bottom-left status bar of the main window provides the USB interface circuit communication status. The bottom-right status bar indicates the presence or absence of the IC.

Software Startup

Upon starting the program, the EV kit software automatically searches for the USB interface circuit connection, and then for the IC's device address. The EV kit enters the normal operating mode when the USB connection is detected and has found the device address. EV kit adapter input-current limit is set to 8192mA. The battery-charging current is set to 0mA. The battery-charging voltage is set to 0mV. The battery-relearn voltage is set to 19200mV and disabled. The IINP voltage is displayed. The device address, device ID, and manufacturer ID are read and displayed. If the USB connection is not detected, the software prompts the user to retry, exit the program, or enter the demo mode.

Demo Mode

The EV kit software can enter the demo mode, when the USB connection is not detected, by selecting **Cancel** on the **MAX17535 Evaluation Kit Interface Circuit** popup window (Figure 2). The software can also enter the demo mode at any time by selecting the **Options | Demo Mode** menu item from the main window menu bar. When in demo mode, all software communication to the EV kit circuit is disabled; however, most of the software GUI is functional. Demo mode allows the user to evaluate the software without hardware connectivity. To exit demo mode, select **Options | Demo Mode** from the menu bar.

0x3F Input Current

The EV kit software's **0x3F Input Current** group box contains checkboxes to set the adapter input-current limit between 256mA to 11008mA. The total adapter input-current limit is displayed in hexadecimal and decimal values inside the **Input Current Write** group box. The **Write** button sends the adapter input-current-limit data and command to the IC. The **Read** button inside the **Input Current Read Back** group box reads back the adapter input-current limit data from the IC. The read-back adapter input-current limit is displayed in hexadecimal and decimal values inside the **Input Current Read Back** group box.

0x14 Charging Current

The EV kit software's **0x14 Charging Current** group box contains checkboxes to set the battery-charging current between 128mA to 8064mA. The total battery-charging current is displayed in hexadecimal and decimal
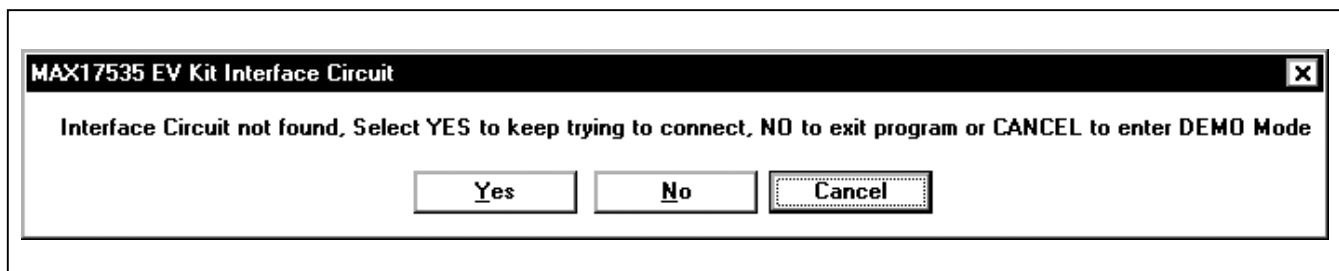
Figure 2. MAX17535 Evaluation Kit Interface Circuit Popup Window

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values inside the **Charging Current Write** group box. The **Write** button sends the battery-charging current data and command to the IC. The **Read** button inside the **Charging Current Read Back** group box reads back the battery-charging current data from the IC. The read-back battery-charging current is displayed in hexadecimal and decimal values inside the **Charging Current Read Back** group box.

Setting the charging current to 0mA terminates the charging process. Uncheck all the charging current scaling checkboxes, and then press the **Write** button in the **0x14 Charging Current** group box to set the charging current to 0mA.

0x15 Charging Voltage
The EV kit software's **0x15 Charging Voltage** group box contains checkboxes to set the battery-charging voltage between 4096mV to 19200mV. The total battery-charging voltage is displayed in hexadecimal and decimal values inside the **Charging Voltage Write** group box. The **Write** button sends the battery-charging voltage data and command to the IC. The **Read** button inside the **Charging Voltage Read Back** group box reads back the battery-charging voltage data from the IC. The read-back battery-charging voltage is displayed in hexadecimal and decimal values inside the **Charging Voltage Read Back** group box.

Setting the charging voltage to less than 4096mV terminates the charging process. Uncheck all the charging voltage scaling checkboxes, and then press the **Write** button in the **0x15 Charging Voltage** group box to set the charging voltage to 0mV.

0x3D Relearn Voltage
The EV kit software's **0x3D Relearn Voltage** group box contains checkboxes to enable and set the battery-relearn voltage between 4096mV to 19200mV. The total battery-relearn voltage is displayed in hexadecimal and decimal values inside the **Relearn Voltage Write** group box. The **Write** button sends the battery-relearn voltage data and command to the IC. The **Read** button inside the **Relearn Voltage Read Back** group box reads back the battery-relearn voltage data from the IC. The read-back battery-relearn voltage is displayed in hexadecimal and decimal values inside the **Relearn Voltage Read Back** group box.

0x3E IINP Voltage
The EV kit software's **0x3E IINP Voltage** group box contains checkboxes to display the IINP voltage. The total IINP voltage is displayed in hexadecimal and decimal values near the bottom of the group box. The IC's IINP voltage is automatically updated every 3s. The **Auto Write/Read every 25 Seconds** checkbox automatically sends a write and read command every 25s to update and read back the data to and from registers 0x3F, 0x14, 0x15, and 0x3D.

Device Address and IDs
The EV kit software's **Device Address and IDs** group box contains the **Read IDs** button and three labels to respectively read and display the IC's SMBus device address, the device ID, and the manufacturer ID.

Reset
The **Reset** button performs the following tasks: sets the adapter input-current limit to 256mA; sets the battery-charging current to 0mA; sets the battery-charging voltage to 0mV; sets the battery-relearn voltage to 19200mV and disables the battery-relearn voltage function; reads and displays the IINP voltage; and reads and displays the device address, device ID, and manufacturer ID.

Keyboard Navigation
Press the TAB key to select each GUI control. Most of the selected control is indicated by a dotted outline. Using SHIFT+TAB moves the selection to the previously selected control. Buttons and checkboxes respond to the keyboard SPACE bar. Some controls respond to the keyboard UP and DOWN arrow keys. Activate the program's menu bar by pressing the F10 key, then press the letter of the desired menu item. When the Alt key is pressed and released, most menu items show one letter underlined, indicating their shortcut key.

Simple SMBus Commands
There are two methods for communicating with the EV kit, through the normal user-interface panel (Figure 1) or by using low-level SMBus commands available through the **Advanced User Interface 2-Wire Interface** tab (Figure 3) from the main program's **Options | Interface (Advance Users)** main menu. A window is displayed that allows SMBus operations, such as **SMBusReadWord** and **SMBusWriteWord**.
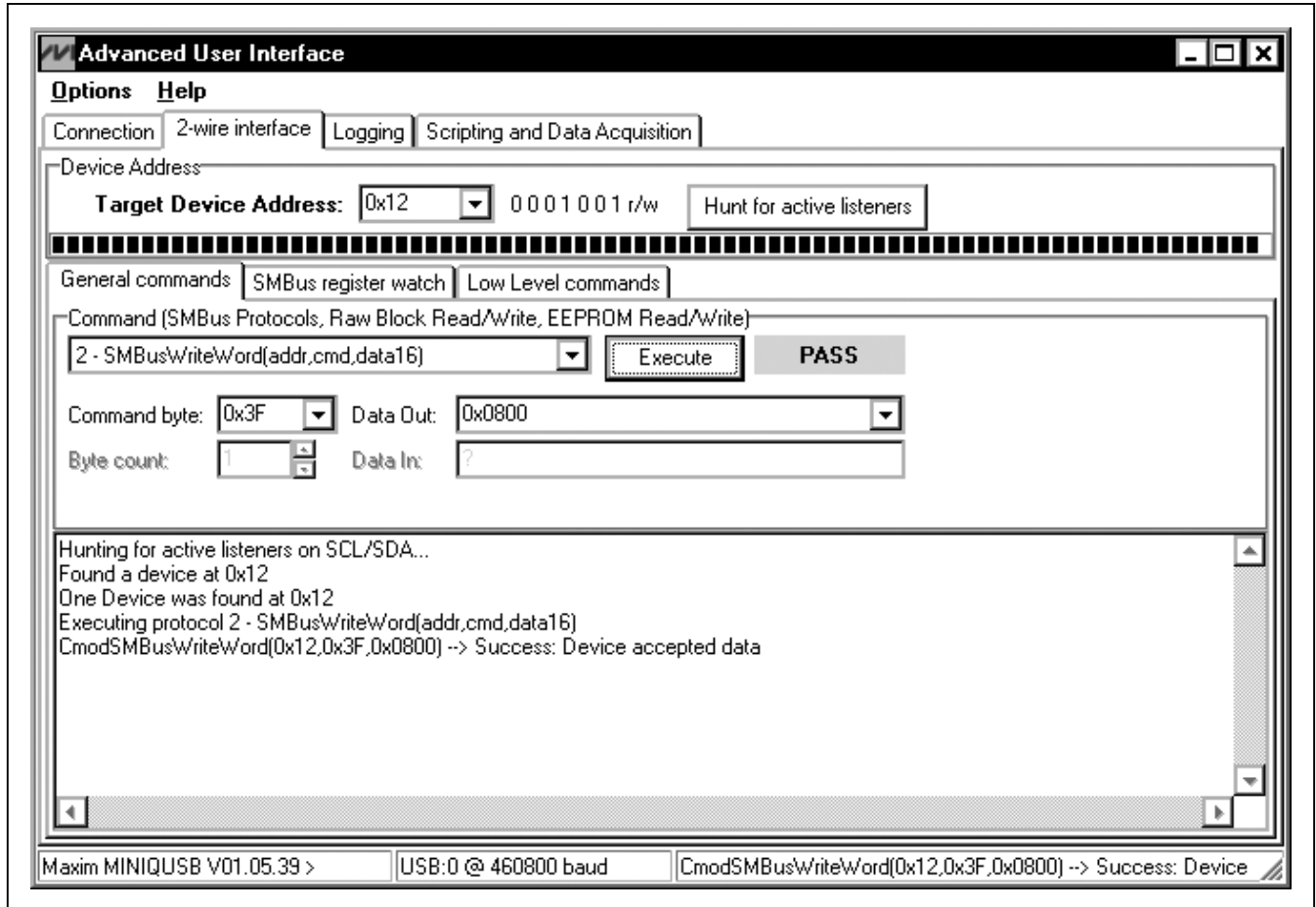
Figure 3. Simple Low-Level 2-Wire Interface

Note: The SMBus dialog boxes accept numeric data in binary, decimal, or hexadecimal. Hexadecimal numbers must be prefixed by $ or 0x. Binary numbers must be exactly eight binary digits. See Figure 3 for an example of this tool. Figure 3 shows a simple SMBus write-word operation using the included 2-wire interface diagnostics tool. In this example, the software is writing data 0x0800 to the register address 0x3F (input current) to the device with the device address 0x12. The data sequence sets the IC's input current to 4096mA.

General Troubleshooting

Problem: Software reports it cannot find the interface circuit.

• Is the interface circuit power LED lit?

• Is the USB cable connected?

• Has Windows plug-and-play detected the board? Bring up Control Panel->System->Device Manager, and look at what device nodes are indicated for USB. If there is an "unknown device" node attached to the USB, delete it—this forces plug-and-play to try again.

• Are jumpers JU1 to JU3 properly configured?

/M/IXI/M

_Detailed Description of Hardware

The MAX17535 EV kit is a complete, fully assembled, and tested PCB that demonstrates the highly integrated MAX17535 controller of a multichemistry battery-charger controller with SMBus-programmable charge current, charge voltage, input-current limit, relearn voltage, and digital readback of the IINP voltage. The charge current, charge voltage, input-current limit, and relearn voltage are programmed through the SMBus-compatible serial interface, communicating at data rates of 100kbps. The SMBus data is sent through an on-board USB interface circuit using a PC or a user-supplied SMBus controller.

The EV kit circuit is capable of supplying power to a system load while simultaneously charging the battery pack. The EV kit circuit integrates a step-down, DC-DC converter to implement a precision constant-current, constant-voltage battery charger. During operation, the EV kit circuit selects the ADAPTER or the BATT input as the main power source for system load (SYSLD). Once the main power source is selected, the EV kit circuit monitors the input source current. This input source current is defined as the combined SYSLD current and battery-charge current when the ADAPTER input is the main power source or as the battery-discharge current when the battery is the main power source. When the input source current exceeds the EV kit input-current-limit threshold, the battery-charge current is reduced to give priority to the system load.

The EV kit features PCB output pads to access the 5.4V, 30mA LDO integrated in the IC. The low-current LDO linear regulator is available for external use. The VAA pad on the EV kit provides access to monitor the IC's internal reference. This 4.096V internal reference voltage is not allowed for external use. The EV kit $\overline{ACOK}$ digital output signal indicates the presence of a valid input source, such as an AC adapter. The IINP analog output signal is a scaled voltage of the total current drawn from the adapter or the battery.

The EV kit uses an IC in a 24-pin TQFN package on a proven 2oz copper, four-layer PCB design. The EV kit operates from an 8V to 24V DC power supply that provides at least 11A. This EV kit supports up to 7A, but is optimized for 4A of charge current.

Input Source

The EV kit requires an 11A power source with an output-voltage range of 8V to 24V connected to the ADAPTER banana jack connector or a power source with an output-voltage range of 8V to 19V connected to the BATT banana jack connector for normal operation. In a typical application, the battery pack is connected to BATT and a DC supply such as an AC adapter can be connected to ADAPTER. When the ADAPTER voltage is higher than 7.2V and DCIN > V_{BATT} - 500mV, the ADAPTER is selected as the main power source. The battery at BATT is charged when the adapter is selected as the main power source and the system load current is less than the input-current limit.

IINP Output Signal

The EV kit features an analog output (IINP) to allow current monitoring through sense resistor R16. The measured current is either the input adapter current (SYSLD current and battery-charging current) or the battery-discharge current. The voltage at the INP output can be calculated with the following equation:

$$V_{IINP} = I_{INPUT} \times R16 \times 20\frac{V}{V}$$

where V_{IINP} is the voltage at the IINP output pad, I_{INPUT} is the ADAPTER input current or the battery-discharge current, and R16 is the value of the sense resistor (10mΩ).

The EV kit provides an option to filter or fine tune the input voltage to the adapter current-sense amplifier in the IC. The RC filter network C37 and R30 provides filtering, while resistor R29 can be installed to form a voltage-dividing network with resistor R30 to provide fine tuning to the input voltage to the adapter current-sense amplifier.

ADAPTLIM Logic Signal

The EV kit features a logic output (ADAPTLIM) to monitor the adapter current limit set by the voltage at the ITHR pin (see the *Jumper Selection* section). The EV kit compares the voltage of the ITHR and IINP pins. If the voltage at the IINP pin exceeds the voltage at the ITHR pin, ADAPTLIM is pulled low. ADAPTLIM is pulled high to 5.4V otherwise.

LDO Linear Regulator

The device includes a low-dropout (LDO) linear regulator. The EV kit circuit provides access to this linear regulator with a PCB pad. The LDO output provides 30mA of available current at 5.4V.

VAA Internal Reference

The EV kit provides a PCB pad to monitor the internal reference voltage (VAA). This internal reference is not for external use.

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ACOK Output Logic Signal

The EV kit features the $\overline{ACOK}$ output logic signal that indicates whether a valid DC source is connected to the ADAPTER banana jack connector. The $\overline{ACOK}$ signal is pulled low to 0V when the voltage at the ADAPTER input is greater than 16.8V. $\overline{ACOK}$ is pulled high (5.4V) otherwise.

Jumper Selection

SMBus Clock and Data Inputs

The EV kit includes clock and data input pins for SMBus-compatible communication to control the IC. The clock and data pins can be driven by the on-board USB interface circuit or directly from an external SMBus-compatible controller. If an external SMBus-compatible controller is available, remove the shunts from jumpers JU1 and JU2, connect the clock, data, and ground signals to the SCL, SDA, and PGND pads, respectively.

Jumpers JU1 and JU2 select the SMBus serial-interface signal-control sources for the IC. Table 1 lists the various options for configuring SMBus input signal controls.

Table 1. JU1 (SCL), JU2 (SDA) Jumper Functions

SHUNT POSITION	SMBus INTERFACE CONTROL SIGNALS CONNECTED TO	SMBus INTERFACE SIGNALS CONTROLLED BY
Installed*	USB interface circuit	USB interface circuit and EV kit software
Not installed	PCB pads	User-supplied external SMBus interface signals

*Default position.

Table 2. JU3 (EN) Jumper Function

SHUNT POSITION	EN PIN CONNECTED TO	EV KIT FUNCTION
Installed*	5.4V (through resistor R26)	EV kit enabled
Not installed	Not connected	Shutdown initiated

*Default position.

Enable

The EV kit circuit features jumper JU3 that pulls the IC's EN pin high to enable the device. Table 2 shows the jumper options for jumper JU3 on the EV kit.

Adapter Current-Limit Threshold

The EV kit circuit features jumper JU4 that selects the adapter current-limit threshold. Table 3 shows the jumper options for jumper JU4 on the EV kit.

Charger Bias Supply Input

The EV kit circuit features jumper JU5 that selects the charger bias supply Input. Table 4 shows the jumper options for jumper JU5 on the EV kit.

Table 3. JU4 (ITHR) Jumper Function

SHUNT POSITION	ITHR PIN CONNECTED TO	ADAPTER CURRENT LIMIT SET TO
1-2	0.9V (LDO through dividing resistors R23 and R25)	4.5A
2-3*	0.675V (LDO through dividing resistors R23 and R24)	3.4A
Not installed	5.4V (LDO through pullup resistor R23)	7A (max)

*Default position.

Table 4. JU5 (DCIN) Jumper Function

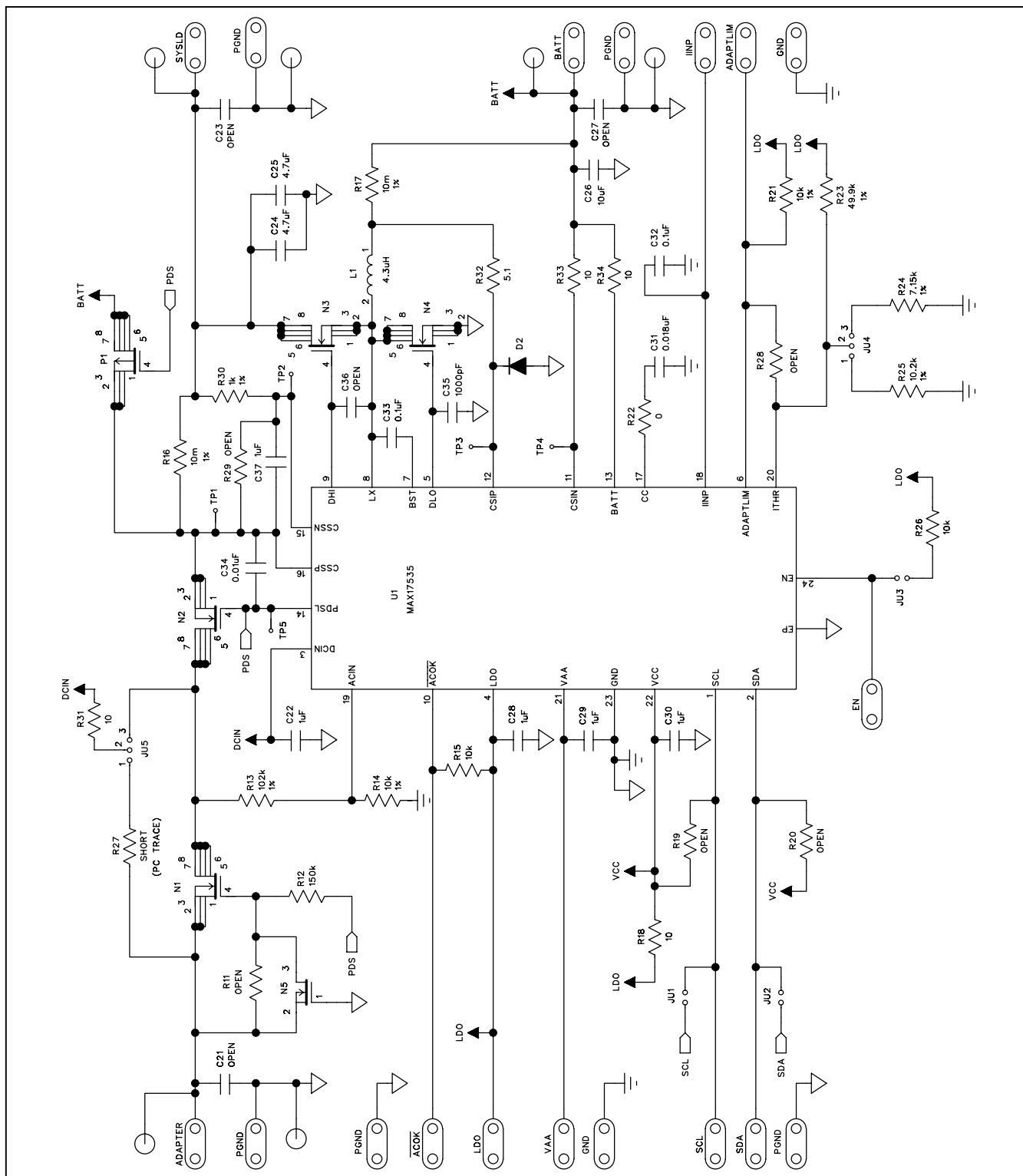| SHUNT POSITION	DCIN PIN CONNECTED TO	CHARGER BIAS SUPPLY INPUT
1-2	ADAPTER PCB pad (through resistor R27)	Powered from the adapter, or shut down if the adapter is removed
2-3*	Midpoint of transistors N1 and N2	Powered from the adapter, or from the battery if the adapter is removed
Not installed	Not connected	Not powered (shutdown)

*Default position.

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Figure 4a. MAX17535 EV Kit Schematic (Sheet 1 of 2)

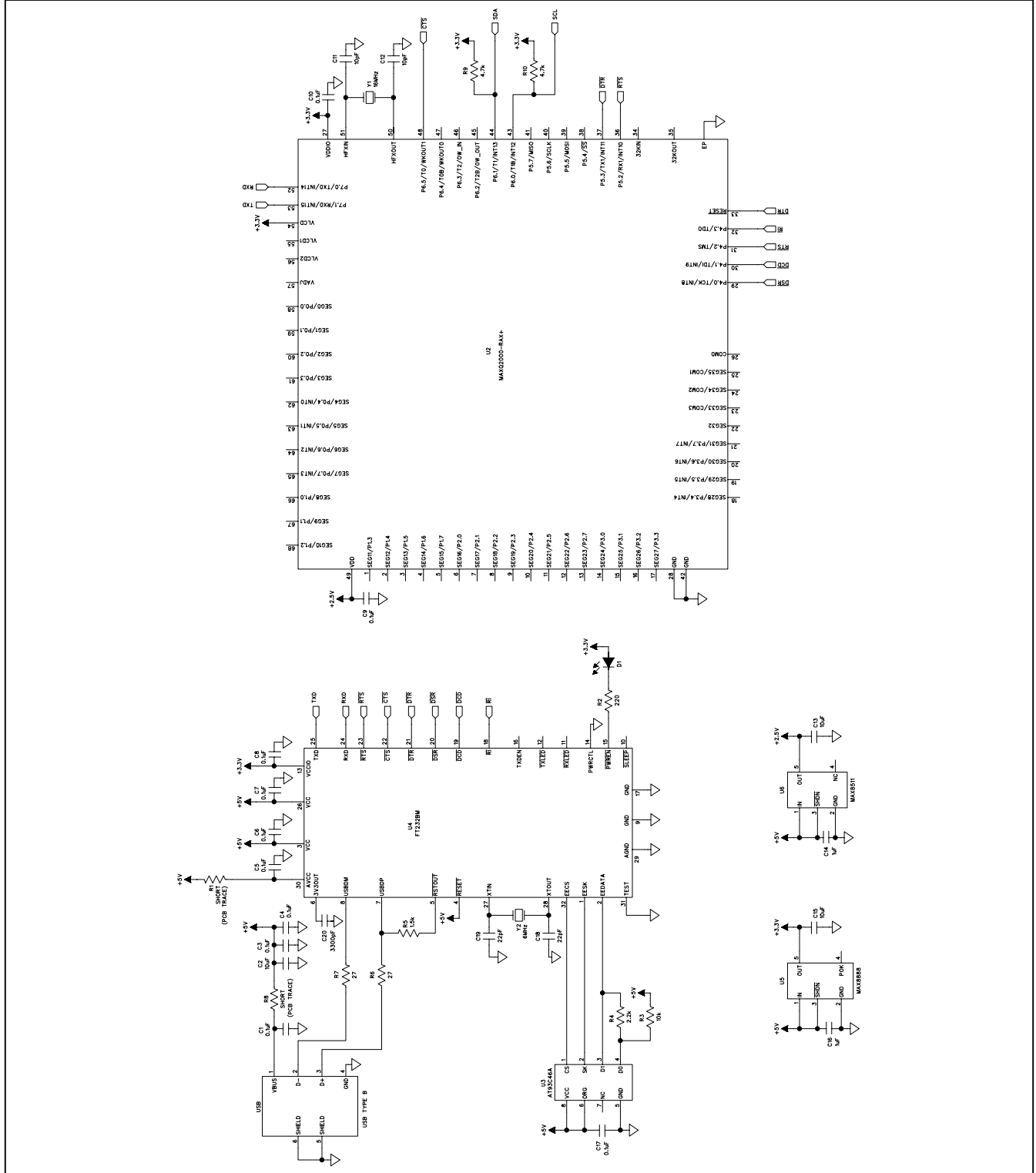Figure 4b. MAX17535 EV Kit Schematic (Sheet 2 of 2)

/VI/IXI/VI
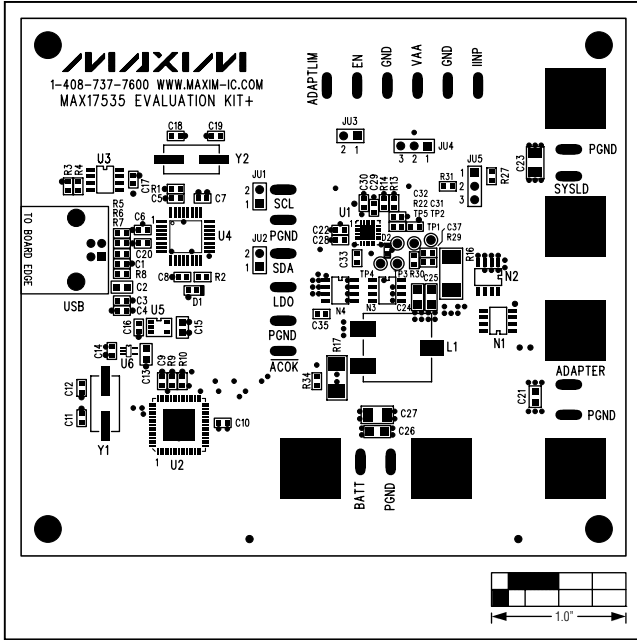
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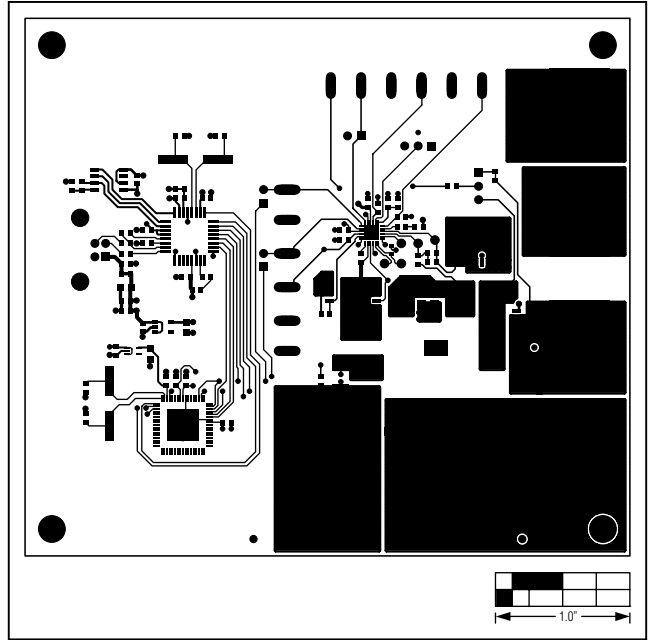Figure 5. MAX17535 EV Kit Component Placement Guide—Component Side
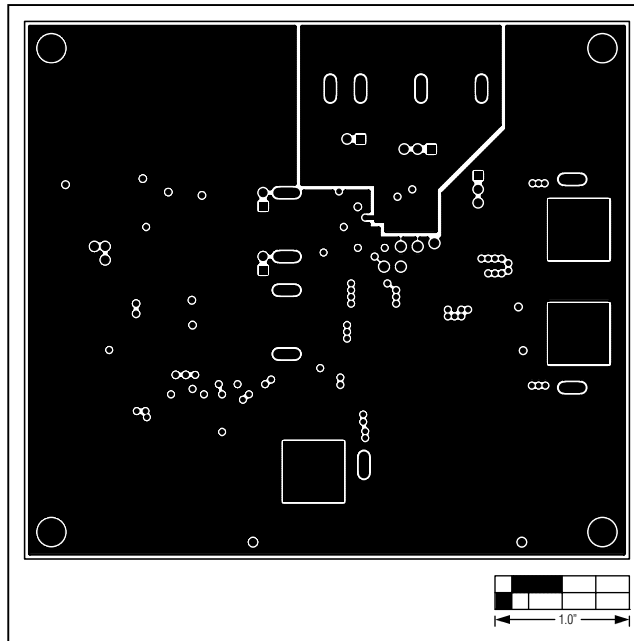

Figure 6. MAX17535 EV Kit PCB Layout—Component Side

Figure 7. MAX17535 EV Kit PCB Layout—GND Layer 2
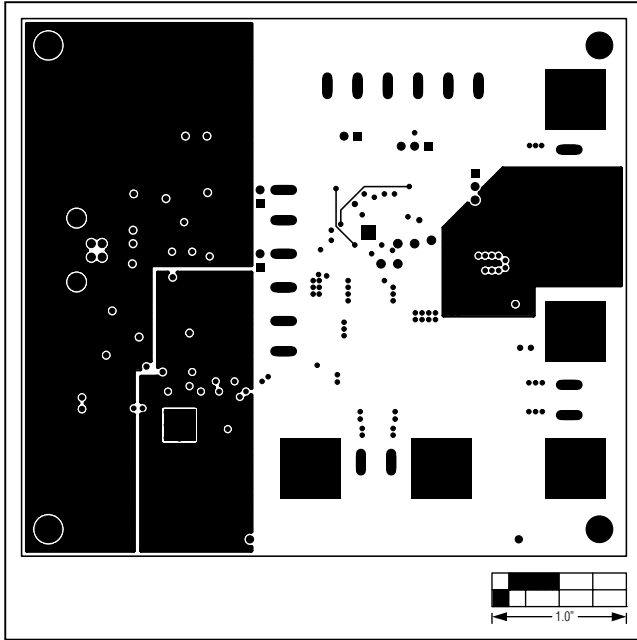
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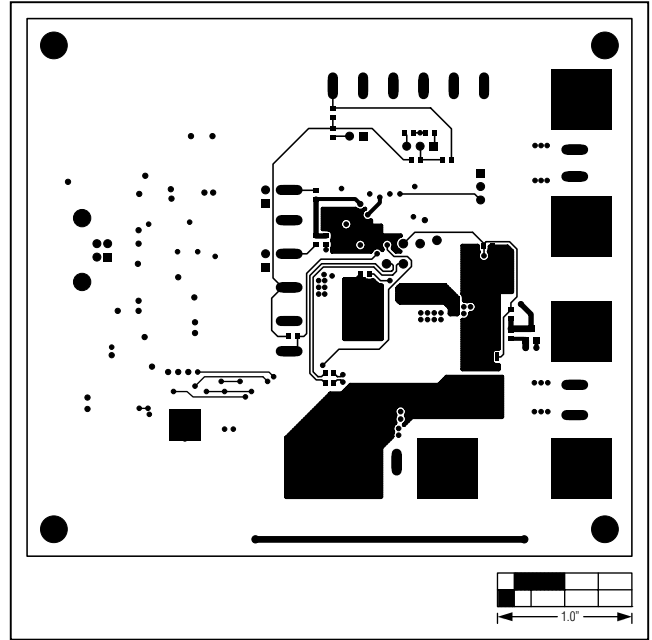
Figure 8. MAX17535 EV Kit PCB Layout—PWR Layer 3
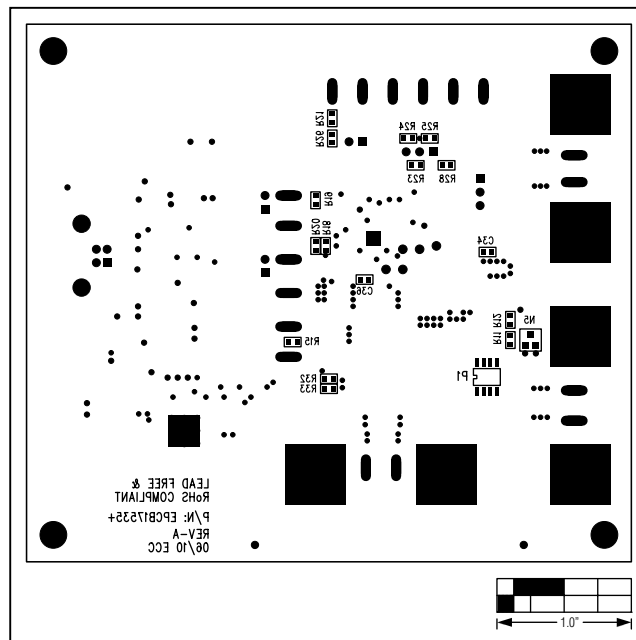

Figure 9. MAX17535 EV Kit PCB Layout—Solder Side

Figure 10. MAX17535 EV Kit Component Placement Guide—
Solder Side

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_____**Revision History**

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	7/10	Initial release	—

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