### **General Description**

The MAX8713 evaluation kit (EV kit) is an efficient, multichemistry battery charger. It uses the Intel system management bus (SMBus<sup>™</sup>) to control the battery regulation voltage and charger current output.

The MAX8713 EV kit can charge one, two, three, or four series Li+ cells with a current up to 2A.

The MAX8713 evaluation system (EV system) consists of a MAX8713 EV kit and the Maxim SMBUSMON2 board. The MAX8713 EV kit includes Windows<sup>®</sup> 95-/98-/2000-/XP-compatible software to provide a userfriendly interface.

#### **Features**

- ♦ 0.6% Battery Voltage Accuracy
- ♦ 5% Battery Charge-Current Accuracy
- Up to 2A Battery Charge Current
- ♦ +8V to +25V Input Voltage Range
- Charge Li+, NiCd, and NiMH Battery Chemistries

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- Cycle-by-Cycle Current Limiting
- SMBus-Compatible 2-Wire Serial Interface
- Includes Windows 95-/98-/2000-/XP-Compatible Software and Demo PC Board
- Fully Assembled and Tested

### Ordering Information

PART	TEMP RANGE	IC PACKAGE	SMBus INTERFACE TYPE
MAX8713EVKIT	0°C to +70°C	24 Thin QFN, 4mm x 4mm	Not included
MAX8713EVSYS	0°C to +70°C	24 Thin QFN, 4mm x 4mm	SMBUSMON2

**Note:** The MAX8713 EV kit software is provided with the MAX8713EVKIT. However, to use the software, the SMBUSMON2 board is required to interface the EV kit to the computer.

### Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	0.1µF ±10%, 50V X7R (1206) ceramic capacitor Murata GRM319R71H104K TDK C3216X7R1H104K
C2, C6, C8	3	1µF ±10%, 10V X5R (0603) ceramic capacitors Murata GRM188R61A105K TDK C1608X5R1A105K
C3, C4, C10	3	0.01µF ±10%, 50V X7R (0603) ceramic capacitors Murata GRM188R71H103K TDK C1608X7R1H103K
C5, C11	2	22μF ±20%, 25V X5R (1812) ceramic capacitors TDK C4532X5R1E226M

DESIGNATION	QTY	DESCRIPTION
C7, C9	2	0.1µF ±10%, 25V X7R (0603) ceramic capacitors Murata GRM188R71E104K TDK C1608X7R1E104K
C12, C13, C14	0	Not installed, 0603
D1	1	Schottky diode, 3A, 40V SMA Central Semiconductor CMSH3-40MA Diodes Inc. B340A
D2, D3	2	Diodes, 1N4148-type, SOD-123 Diodes Inc. 1N4148W Fairchild Semiconductor MMSD4148
J1	1	2 x 10 right-angle female receptacle
J2	1	Smart-battery header assembly, right angle, keyless, 5 position TYCO Electronics (AMP) 787441-1

SMBus is a trademark of Intel Corp. Windows is a registered trademark of Microsoft Corp.

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DESIGNATION	QTY	DESCRIPTION
1.1	-	22 $\mu$ H, 2.6A, 75m $\Omega$ inductor
		Sumida CDRH8D43-220NC
		MOSFETs, dual n-channel, 7.5A, 30V,
N1A, N1B	2	8-pin SO
		Fairchild Semiconductor FDS6990A
R1	1	10k $\Omega$ ±5% (0603) resistor
R2	1	$33\Omega \pm 5\%$ (0603) resistor
R3	1	100k $\Omega$ ±5% (0603) resistor
		0.04Ω ±1%, 0.5W (2010) sense
D4	- 1	resistor
N4	1	Vishay Dale WSL2010 0.040 1.0%
		IRC LRC-LR2010-01-R040-F
R5-R8	0	Not installed, 0603
111	1	MAX8713ETG, 24-pin, 4mm x 4mm,
		thin QFN
None	1	PC board MAX8713 EV kit

### **Component List (continued)**

### \_Quick Start

#### **Recommended Equipment**

- DC source to supply the input current to the charger—this source must be capable of supplying a voltage greater than the battery-voltage set point and have sufficient current rating
- Voltmeter
- Smart battery
- Computer running Windows 95, 98, 2000, or XP
- 9-pin serial extension cable
- SMBUSMON2 board

#### Procedure

The MAX8713 EV kit is a fully assembled and tested board. Follow the steps below to verify board operation. Do not turn on the power supply until all connections are completed. Observe all precautions on the battery manufacturer's data sheet.

- 1) Set the VPP jumper on the SMBUSMON2 board to VCC5.
- 2) Carefully connect the boards by aligning the 20-pin connector of the MAX8713 EV kit with the 20-pin header of the SMBUSMON2 board. Gently press them together.
- 3) Connect a cable from the computer's serial port to the SMBUSMON2 interface board. Use a straight-through 9-pin female-to-male cable.

- 4) Install the software by running the INSTALL.EXE program. The install program copies the files and creates icons for them in the Windows 95/98/2000/XP Start menu. An uninstall program is included with the software. Click on the UNINSTALL icon to remove the EV kit software from the hard drive.
- 5) Connect power to the SMBUSMON2 board.
- 6) Connect the input-current supply across the ADAPTER\_IN and PGND pads.
- 7) Connect a smart battery to connector J2.
- 8) Turn on the power supply.
- 9) Start the MAX8713 EV kit software.
- 10) Verify current is being delivered to the battery.

### **Detailed Description of Software**

The MAX8713 program provides easy access to the MAX8713 registers. It is also capable of reading the registers of a smart battery and monitoring SMBus traffic.

Upon execution of the program, the software enables the MAX8713 smart-charger command panel (Figure 1), after which any of the allowed SMBus commands can be sent to the MAX8713. Refer to the MAX8713 data sheet for more information regarding the allowed SMBus commands.

#### **Smart Charger Command Panel**

#### ChargeVoltage()

To issue the ChargeVoltage() command to the MAX8713, enter the desired voltage, in millivolts, into the Charging Voltage edit field and select the adjacent **Write** button.

#### ChargeCurrent()

To issue the ChargeCurrent() command to the MAX8713, enter the desired current, in milliamps, into the Charging Current edit field and select the adjacent **Write** button.

#### ManufacturerID()

ManufacturerID() returns the manufacturer ID (0x004D) from the MAX8713. This command is available through the Other Bitmapped Charger Registers... panel (Figure 2). Select manufacturer ID by picking it from the pull-down list located directly under the Other Bitmapped Charger Registers... label. Issue a ManufacturerID() command by selecting the **Read** button. The returned hexadecimal value is shown at the bottom of the panel.



#### DeviceID()

DeviceID() returns the device ID (0x0007) from the MAX8713. This command is available through the Other Bitmapped Charger Registers... panel (Figure 2). Select device ID by picking it from the pulldown list located directly under the Other Bitmapped Charger Registers... label. Issue a DeviceID() command by selecting the **Read** button. The returned hexadecimal value is shown at the bottom of the panel.

#### **Smart-Battery Command Panel**

The software is capable of reading the registers of a smart battery. The smart-battery page of the software is shown in Figure 3. The software only reads the registers selected with checkmarks. By default, the registers are automatically read once every 2s. Disable this feature by unselecting the Active Read: Battery checkbox located on the Timer panel. Change the refresh time by entering a new value into the Timer Interval edit box and select the **Set Interval** button. When autorefresh is disabled, read the battery by selecting the **Refresh** button.

### \_Detailed Description of Hardware

The MAX8713 includes all of the functions necessary to charge a smart battery. The EV kit is capable of charging with a maximum 2.016A current and a maximum 19.2V voltage. For more information on the operation of the MAX8713, refer to the *Detailed Description* section of the MAX8713 data sheet.

#### **Connecting a Smart Battery**

The MAX8713 EV kit includes a five-pin smart-battery connector. To connect a smart battery to the EV kit, turn off power to the EV kit and connect the battery, making sure to correctly orient the connectors.

#### **Evaluating the MAX8713 Above 25V**

To evaluate the MAX8713 with an input voltage greater than 25V (up to 28V), capacitor C5 must be replaced with a higher-voltage-rating part.

### Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
Central Semiconductor	631-435-1110	631-435-1824	www.centralsemi.com
Diodes Inc.	805-446-4800	805-446-4850	www.diodes.com
Fairchild Semiconductor	888-522-5372	—	www.fairchildsemi.com
International Resistive Co. (IRC)	361-992-7900	361-992-3377	www.irctt.com
Murata	770-436-1300	770-436-3030	www.murata.com
Sumida	847-545-6700	847-545-6720	www.sumida.com
TDK	847-803-6100	847-390-4405	www.component.tdk.com
Vishay Dale	402-564-3131	402-563-6296	www.vishay.com

*Note:* Indicate you are using the MAX8713 when contacting these manufacturers.

File Logging	Interfa	ce Script	Help
-Timer	System	Overview 🛛 G	ieneric Smart Battery
Timer Interval: 2 sec	Si	mart Charger o	described in file: MA
Set Interval	Ox13 C	hargerStatus-	
	1 (10)	-	Read
Run Running	Bit O	reserved	1
Stop	Bit 1	reserved	0
	Bit 2	reserved	1
Stop if error	Bit 3	reserved	1
	Bit 4	reserved	0
	Bit 5	reserved	0
Timer Action:	Bit 6	reserved	1
	Bit 7	reserved	0
Active	Bit 8	reserved	0
neau.	Bit 9	reserved	0
Batteru	Bit 10	reserved	0
	Bit 11	reserved	0
	Bit 12	reserved	0
	Bit 13	reserved	0
	Bit 14	reserved	0
O Passive	Bit 15	reserved	0.004
SMBus	(M2B)		0X004I

imer	System Overview Generic Smart Batter	y (0x16) MAX8713 Smart Charger (0x12) SMBus	Interface SMBus Scripting SMBus Traffic
imer Interval: 2 sec	Smart Charger described in file: M	IAX8713.INI	Other Bitmapped Charger Registers OxFE:R ManufacturerID
Set Interval Run Running Stop Stop	Ox13 ChargerStatus (LSB) Read Bit 0 reserved Bit 1 reserved Bit 2 reserved Bit 3 reserved Bit 4 reserved Bit 4 reserved Bit 5 reserved	Ox12 ChargerMode           I         Bit 0         reserved         1           0         Bit 1         reserved         1           1         Bit 2         reserved         1           1         Bit 3         reserved         1           1         Bit 3         reserved         1           0         Bit 4         reserved         1           0         Bit 5         reserved         1	Read     Write       Bit 0     ManufacturerID_bit0     ?     1       Bit 1     ManufacturerID_bit1     ?     1       Bit 2     ManufacturerID_bit2     ?     1       Bit 3     ManufacturerID_bit3     ?     1       Bit 4     ManufacturerID_bit4     ?     1       Bit 5     ManufacturerID_bit4     ?     1
imer Action: ● Active Read: ■ System ■ Battery ■ Charger Passive SMBus traffic monitoring	Bit 6 reserved Bit 7 reserved Bit 7 reserved Bit 8 reserved Bit 9 reserved Bit 10 reserved Bit 11 reserved Bit 12 reserved Bit 13 reserved Bit 14 reserved Bit 15 reserved (MSB) 0x000 -0x14 ChargingCurrent 1000 mA Write	0         Dit 3         reserved         1           1         Bit 6         reserved         1           0         Bit 7         reserved         1           0         Bit 8         reserved         1           0         Bit 9         reserved         1           0         Bit 10         reserved         1           0         Bit 11         reserved         1           0         Bit 12         reserved         1           0         Bit 12         reserved         1           0         Bit 12         reserved         1           0         Bit 13         reserved         1           0         Bit 14         reserved         1           0         Bit 15         reserved         1           0         Bit 15         reserved         1           0         Bit 15         reserved         1           0         Dit 14         reserved         1           0         Bit 15         reserved         1           0         MXB         0x?????         0x?????	bit 6       ManufacturerID_bit6       ?       1         Bit 7       ManufacturerID_bit8       ?       1         Bit 8       ManufacturerID_bit8       ?       1         Bit 9       ManufacturerID_bit8       ?       1         Bit 9       ManufacturerID_bit9       ?       1         Bit 10       ManufacturerID_bit10       ?       1         Bit 11       ManufacturerID_bit12       ?       1         Bit 12       ManufacturerID_bit12       ?       1         Bit 13       ManufacturerID_bit12       ?       1         Bit 14       ManufacturerID_bit14       ?       1         Bit 15       ManufacturerID_bit15       ?       1         (MSB)       0x????       0x????       1
	Data Refresh	Read (1) passed	Read ??? ??? Write Read Refresh

Figure 1. MAX8713 Smart-Charger Command Panel

le Logging	Interface Script Help				Dava a Dava	
iner	System Overview Generic S	mart Battery (Ux1)	6] MAX8713 Smart Charg	jer (UX12) SMBus	Interface SMBus Scripting SMBu	s Traffic
imer intervai:	Smart Charger describer	t in file: MAX87	13 INI 👻		Other Bitmapped Charger Registers	<u>}</u>
					0xFE:R ManufacturerID	<u> </u>
Set Interval	-Ox13 ChargerStatus		0x12 ChargerMode		0xFE:R ManufacturerID	
	(LSB)	Read	(LSB)	Write	(LSB)	
nunning	Bit 0 reserved	1	Bit 0 reserved		Bit 0 ManufacturerID_bit0	? 🔲 1
Stop	Bit 1 reserved	0	Bit 1 reserved	<u> </u>	Bit 1 ManufacturerID_bit1	? 🔲 1
	Bit 2 reserved	1	Bit 2 reserved		Bit 2 ManufacturerID_bit2	? []]
Stop if error	Bit 3 reserved	'	Bit 3 reserved		Bit 3 ManufacturerID_bit3	<ul> <li>E1</li> </ul>
	Bit 4 reserved	0	Bit 4 reserved	!	Bit 4 ManufacturerID_bit4	? 🔲
	Bit 5 reserved	0	Bit 5 reserved		Bit 5 ManufacturerID_bit5	? []
imer Action:	Bit b reserved		Bit b reserved	님님	Bit 6 ManufacturerID_bit6	
Active	DK7 Teserveu	0	Dit 7 Teserveu			
Read:	Bit 8 reserved	0	Bit 8 reserved		Bit 8 ManufacturerID_bit8	? []
System	Bit 9 reserved	U	Bit 9 reserved	님님	Bit 9 ManufacturerID_bit9	2 []
Battery	Bit IU reserved	0	Bit IU reserved	님님	Bit IU ManufacturerID_bit IU	
🔽 Charger	DIL II IESEIVEU	0	DICTT TESETVED		Bit IT ManufacturenD_bit IT	
	Bit 12 reserved	0	Bit 12 reserved		Bit 12 ManufacturerID_bit12	? []
	Bit 13 reserved	0	Bit 13 reserved	님님	Bit 13 ManufacturerID_bit13	
Bassius	Bit 15 reserved	0	Bit 15 received	금리	Bit 14 ManufacturerID_bit15	· □· 2 □1
or assive	(MSB)	0x004D	(MSB)	0x????	(MSB)	0x????
SMBus			( )			
monitoring	Ox14 ChargingCurrent		0x15 ChargingVoltage		Other Numeric Charger Registers	
	1000 mA	Write	18000 mV	Write		*
	Auto Re-Write		Auto Re-Write			
	L				Read ???	Write
	Data Refresh					
		В	ead (10) passed			Befresh

Figure 2. MAX8713 Smart-Charger Command Panel Showing the Pulldown List for Manufacturer ID and Device ID

**Evaluate: MAX8713** 

imer	System Overview Generic Smart Bat	tery (0x16) MAX8713 S	mart Charger (0x12) SMBus Interface SM	Bus Scripting SMBus Traffic
imer Interval:	Smart Battery o	described in file: BATTE	BY.INI	
2 sec	Smart Battery Settings			
Set Interval	🔽 0x00 Manufacturer Access	0xCD76	🔽 0x10 Full Charge Capacity	1602 mAh
	🔽 0x01 Remaining Capacity Alarm	300 mAh	🔽 0x11 Run Time to Empty	65535 minutes
	🔽 0x02 Remaining Time Alarm	10 minutes	🔽 0x12 Average Time to Empty	65535 minutes
itop	🔽 0x03 Battery Mode	0x0080 mAł	n Ox13 Average Time to Full	41 minutes
Stop if error	🔽 0x04 At Rate	-30232 mA	Vx14 Charging Current	2000 mA
	Apply Selected Changes (0x00	0x04 writeable)	🔽 0x15 Charging Voltage	16800 mV
imer Action:	✓ 0x05 At Bate Time to Full	65535 minutes	🔽 0x16 Battery Status	0x0290
Active	Ox06 At Bate Time to Empty	0 minutes	🔽 0x17 Cycle Count	202 cycles
Read:	☑ 0x07 At Bate 0K	Inue	🔽 0x18 Design Capacity	3000 mAh
System	☑ 0x08 Temperature	299.3 K 26.2 C	🔽 0x19 Design Voltage	14800 mV
Charger	V 0x09 Voltage	16224 mV	🔽 0x1A Specification Info	0x0010
	V 0x0A Current	1951 mA	🔽 0x1B Manufacture Date	5/13/1999
	V 0x0B AverageCurrent	1951 mA	🔽 0x1C Serial Number	24127
) Passive	☑ 0x0C Max Error	100 %	🔽 0x20 Manufacturer Name	NME
SMBus traffic	Ox0D Belative State of Charge	13 %	🔽 0x21 Device Name	42-1848
monitoring	OxOE Absolute State of Charge	7%	🔽 0x22 Device Chemistry	LION
	✓ 0x0E Remaining Capacity	220 mAh		
		220 11411		
	Ux23 Mfgr Data { 0x42 0x44 0x5	9 0x4E 0x41 }		
	Data Refresh	E L L L L L L L L L L L L L L L L L L L	e old data	
	Hetresh Select All	Select None	PECs	g Un Logging Ult Llose Log

Figure 3. Smart-Battery Command Panel



Figure 4. MAX8713 EV Kit Schematic



7



Figure 5. MAX8713 EV Kit Schematic—Smart-Battery Connector



Figure 6. MAX8713 EV Kit Component Placement Guide—Component Side



Figure 7. MAX8713 EV Kit PC Board Layout—Component Side





Figure 8. MAX8713 EV Kit PC Board Layout—VDD and Power Ground Plane



Figure 9. MAX8713 EV Kit PC Board Layout—Ground Plane



Figure 10. MAX8713 EV Kit PC Board Layout—Solder Side

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