19-0785; Rev 0; 4/07

High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

General Description

The MAX8804Y/MAX8804Z intelligent, dual-input, stand-alone, constant-current, constant-voltage (CCCV), thermally regulated linear chargers are designed for a single-cell lithium-ion (Li+) battery. They integrate the current-sense circuit, MOS pass element, thermal-regulation circuitry, and overvoltage protection (OVP), and eliminate the reverse-blocking Schottky diode to create a simple and small charging solution for handheld equipment.

The MAX8804Z functions as a stand-alone charger to control the charging sequence from the prequalification state through fast-charge, top-off charge, and full-charge indication. The MAX8804Y eliminates the pre-qualification state to allow startup into a load without a battery. Proprietary thermal-regulation circuitry limits the die temperature when fast-charging or while exposed to high ambient temperatures, allowing maximum charging current without damaging the IC.

The MAX8804Y/MAX8804Z achieve high flexibility by providing an adjustable DC/USB fast-charge current through a simple single-wire interface (SET input). The chargers automatically select between either a USB or AC adapter input source. The AC adapter charge current is programmable from 400mA to 700mA in 50mA steps through a serial interface. The USB charge current is programmable to 95mA, 380mA, or 475mA through the same interface. Other features include an active-low battery charging-status indicator ($\overline{CHG}$), an active-low power-OK indicator ($\overline{POK}$), and an active-low USB input detection output ($\overline{USBPWR}$).

The MAX8804Y/MAX8804Z accept a 4.15V to 30V DC source voltage or a 4.15V to 16V USB input voltage, but disable charging when either input voltage exceeds 7.5V to protect against unqualified or faulty input sources. The MAX8804Y/MAX8804Z operate over the extended temperature range (-40°C to +85°C) and are available in a tiny 8-pin thermally enhanced 2mm x 3mm TDFN package.

Applications

Cell Phones/Smartphones

Digital Cameras

Portable Media Players

MP3 Players

Other Handheld Devices

Pin Configuration appears at end of data sheet.

Features

- ♦ **Complete Chargers for Single-Cell Li+ Battery**
- ♦ **Dual-Input, 30V AC Adapter/16V USB**
- ♦ **No External FET, Blocking Diode, or Sense Resistor Required**
- ♦ **Automatic USB/AC Adapter Input Selection**
- ♦ **Easy Programmable Fast-Charge Current and Top-Off Threshold**
- ♦ **Proprietary Die Temperature Regulation Control**
- ♦ **±5% Fast-Charge Current-Limit Accuracy**
- ♦ **Power-Present and Charger-Status Outputs**
- ♦ **No Prequalification Charge (MAX8804Y)**
- ♦ **Tiny 2mm x 3mm Thermally Enhanced TDFN Package**
- ♦ **USB Charging Protected by US Patent #6,507,172**

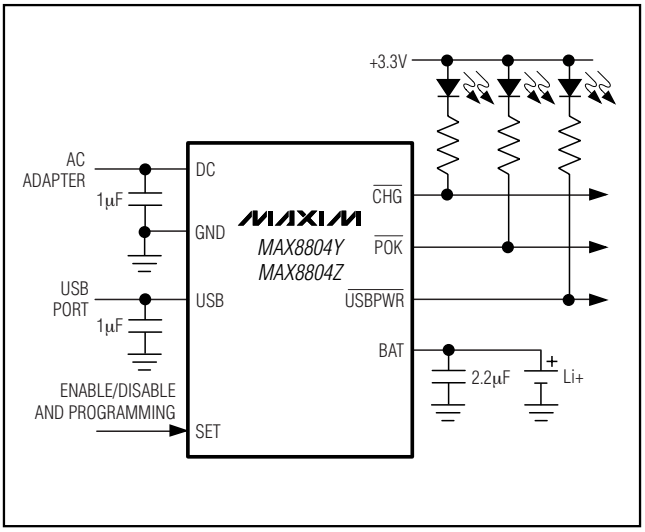
Ordering Information

PART	PIN-PACKAGE	PKG CODE	TOP MARK
MAX8804YETA+	8 TDFN-EP*	T823+1	AAD
MAX8804ZETA+	8 TDFN-EP*	T823+1	AAC

**EP = Exposed paddle.*
+Denotes a lead-free package.

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

Typical Application Circuit



High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

ABSOLUTE MAXIMUM RATINGS

DC to GND .....-0.3V to +30V
USB to GND .....-0.3V to +16V
BAT, CHG, SET, POK, USBPWR to GND .....-0.3V to +5.5V
Continuous Power Dissipation (T_A = +70°C)
8-Pin TDFN 2mm x 3mm (derate 16.7mW/°C above +70°C) (multilayer board).....1333mW

Operating Temperature Range .....-40°C to +85°C
Junction Temperature.....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

((V_{DC} = 5V, V_{SET} = 0V) or (V_{USB} = 5V, V_{SET} = 5V), V_{BAT} = unconnected, T_A = -40°C to +85°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
DC AND USB						
DC Input Voltage Range			0		28	V
USB Input Voltage Range			0		14	V
Input Operating Range	(Notes 2, 3)		4.15		7.00	V
Input Undervoltage Threshold	V_{IN} rising, 500mV hysteresis (typ) (Note 2)		3.85	4.0	4.15	V
Input Overvoltage Threshold	V_{IN} rising, 200mV hysteresis (typ) (Note 2)		7.2	7.5	7.8	V
DC Input Supply Current	V_{USB} = 0V, I_{BAT} = 0mA, charge mode			800	1200	µA
	V_{SET} = 5V, standby mode			300	550	
	V_{DC} = V_{BAT} = 4.3V, shutdown mode			300	550	
USB Input Supply Current	V_{DC} = 0V, V_{SET} = 5V, I_{BAT} = 0mA, charge mode			800	1200	µA
	V_{SET} = 0V, standby mode			300	550	
	V_{USB} = V_{BAT} = 4.3V, shutdown mode			300	550	
DC to BAT On-Resistance	V_{DC} = 3.7V, V_{BAT} = 3.6V			0.55	1.0	Ω
USB to BAT On-Resistance	V_{USB} = 3.7V, V_{BAT} = 3.6V			0.65	1.2	Ω
Input to BAT Comparator Threshold (Note 2)	V_{IN} rising		145	260	385	mV
	V_{IN} falling			55		
BAT						
BAT Regulation Voltage	I_{BAT} = 0mA	T_A = +25°C	4.179	4.200	4.221	V
		T_A = -40°C to +85°C	4.158	4.200	4.242	
Battery Removal Detection Threshold	V_{BAT} rising		4.40	4.67	4.90	V
	Hysteresis			0.1		
DC Charging Current	V_{USB} = 0V, V_{BAT} = 3.6V, rising edge detection on SET	Default and 1st to 3rd interface pulse	475	500	525	mA
		4th to 7th interface pulse	523	550	578	
		8th to 11th interface pulse	570	600	630	
		12th to 15th interface pulse	428	450	473	
		16th to 19th interface pulse	380	400	420	
		20th to 23rd interface pulse	618	650	683	
		24th to 27th interface pulse	665	700	735	

ELECTRICAL CHARACTERISTICS (continued)

((V_{DC} = 5V, V_{SET} = 0V) or (V_{USB} = 5V, V_{SET} = 5V), V_{BAT} = unconnected, T_A = -40°C to +85°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
USB Charging Current	V_{DC} = 0V, V_{BAT} = 3.6V, rising edge detection on SET	Default		90	95	100	mA
		1st interface pulse		360	380	400	
		2nd interface pulse		450	475	500	
Soft-Start Time	Ramping time from 0 to 500mA				250		µs
BAT Prequal Threshold	MAX8804Z only, V_{BAT} rising, 300mV hysteresis (typ)			2.35	2.50	2.65	V
BAT Prequal Charge Current	MAX8804Z only				95		mA
BAT Leakage Current	V_{DC} = V_{USB} = 0V, V_{BAT} = 4.2V					2	µA
SET							
Logic Input Thresholds	V_{SET} rising					1.6	V
	V_{SET} falling			0.4			
Logic-High Time	Pulse width required to program DC charge current			1		1000	µs
Logic-Low Time	Pulse width required to program USB charge current			1		1000	µs
SET DC Mode Shutdown Delay	V_{USB} = 0V, V_{DC} = 5V, measured from V_{SET} low to high			1.5	2	2.5	ms
SET USB Mode Shutdown Delay	V_{DC} = 0V, V_{USB} = 5V, measured from V_{SET} high to low			1.5	2	2.5	ms
SET Internal Pulldown Resistor					2	4	MΩ
$\overline{POK}$, $\overline{CHG}$, $\overline{USBPWR}$							
Logic Output-Voltage Low	$I_{\overline{POK}}$ = $I_{\overline{CHG}}$ = $I_{\overline{USBPWR}}$ = 5mA				60	500	mV
Logic Output-Current High	$V_{\overline{POK}}$ = $V_{\overline{CHG}}$ = $V_{\overline{USBPWR}}$ = 5.5V, V_{DC} = V_{USB} = 0V	T_A = +25°C			0.001	1	µA
		T_A = +85°C			0.01		
$\overline{CHG}$							
$\overline{CHG}$ Top-Off Threshold	I_{BAT} falling, battery is charged, rising edge on SET	V_{DC} = 0V, V_{USB} = 5V		60	80	100	mA
		V_{DC} = 5V, V_{USB} = 0V	Default, 4th, 8th, 12th, 16th, 20th, 24th, 28th interface pulse	60	80	100	
			1st, 5th, 9th, 13th, 17th, 21st, 25th interface pulse	67.5	90	112.5	
			2nd, 6th, 10th, 14th, 18th, 22nd, 26th interface pulse	75	100	125	
			3rd, 7th, 11th, 15th, 19th, 23rd, 27th interface pulse	52.7	70	87.5	

High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

ELECTRICAL CHARACTERISTICS (continued)

((V$_{DC}$ = 5V, V$_{SET}$ = 0V) or (V$_{USB}$ = 5V, V$_{SET}$ = 5V), V$_{BAT}$ = unconnected, T$_A$ = -40°C to +85°C, unless otherwise noted.) (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$\overline{CHG}$ Hysteresis	I$_{BAT}$ rising after top-off is detected (Note 4)	DC mode		57		mA
		USB mode		51		
$\overline{CHG}$ Detection Delay	I$_{BAT}$ falls below top-off threshold		3	4	5	ms
THERMAL LOOP						
Thermal-Regulation Set Point	Junction temperature when the charge current is reduced, T$_J$ rising			+105		°C
Thermal-Regulation Gain	Reduction of I$_{BAT}$ for increase of T$_J$	DC charging		-40		mA/°C
		USB charging		-24		

Note 1: Devices are 100% production tested at T$_A$ = +25°C. Limits over the operating temperature range are guaranteed by design and characterization.

Note 2: V$_{IN}$ refers to the input for the IC. For the MAX8804Y/MAX8804Z, V$_{IN}$ is V$_{DC}$ with V$_{USB}$ = 0V or V$_{USB}$ with V$_{DC}$ = 0V.

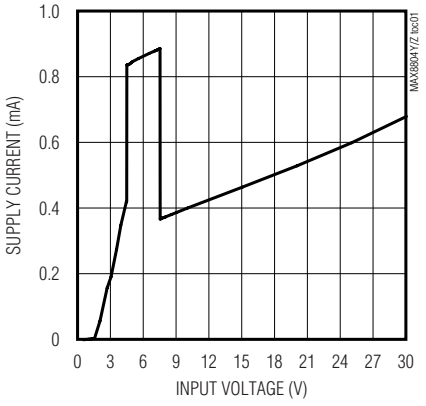
Note 3: Guaranteed by undervoltage and overvoltage threshold testing. For charge completion, the input voltage must be greater than 4.28V.

Note 4: This hysteresis is for all charge current except 95mA. In the case of 95mA charge current, voltage-mode to current-mode detection gives indication of charge mode.

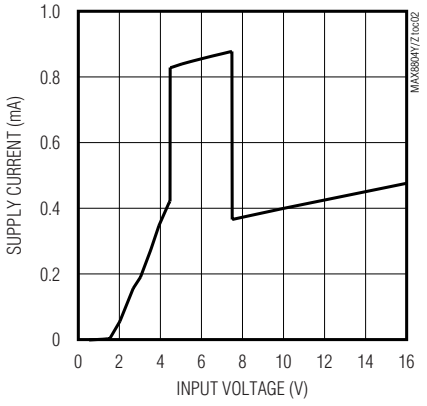
Typical Operating Characteristics

(V$_{BAT}$ = 3.6V; DC charge mode: V$_{DC}$ = 5V, V$_{USB}$ = 0V, V$_{SET}$ = 0V or unconnected; USB charge mode: V$_{USB}$ = 5V, V$_{DC}$ = 0V, V$_{SET}$ = 5V; T$_A$ = +25°C, unless otherwise noted.)

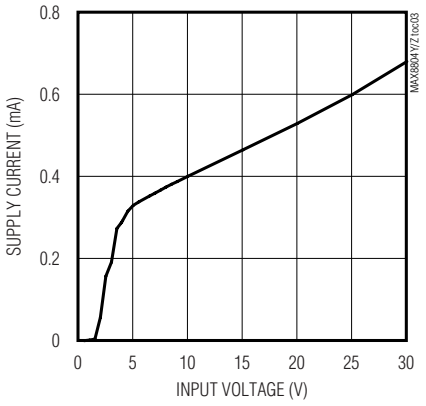
SUPPLY CURRENT vs. INPUT VOLTAGE (DC CHARGING MODE)



SUPPLY CURRENT vs. INPUT VOLTAGE (USB CHARGING MODE)



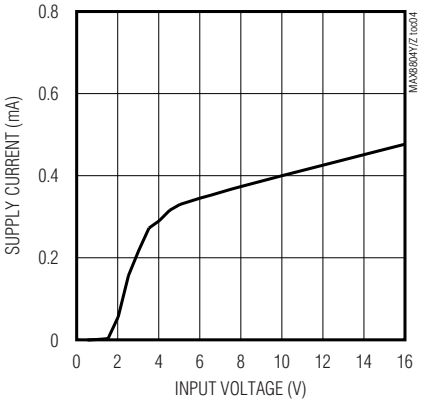
DISABLED-MODE SUPPLY CURRENT vs. INPUT VOLTAGE (DC CHARGING MODE)



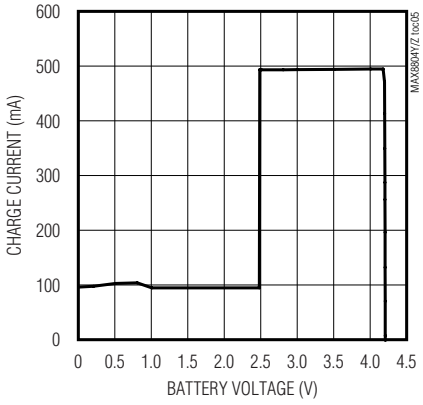
Typical Operating Characteristics (continued)

(V_{BAT} = 3.6V; DC charge mode: V_{DC} = 5V, V_{USB} = 0V, V_{SET} = 0V or unconnected; USB charge mode: V_{USB} = 5V, V_{DC} = 0V, V_{SET} = 5V; T_A = +25°C, unless otherwise noted.)

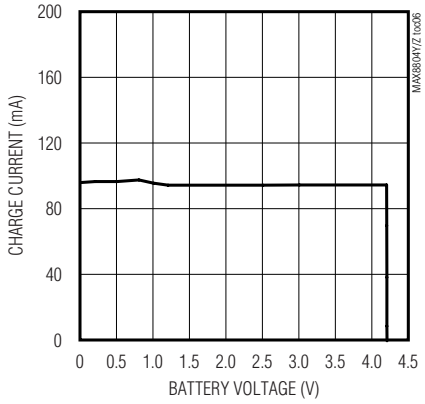
STANDBY-MODE SUPPLY CURRENT vs. INPUT VOLTAGE (USB CHARGING MODE)



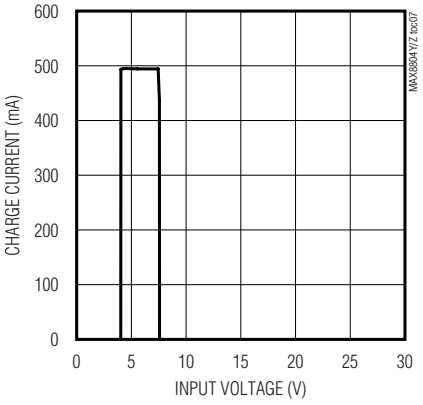
CHARGE CURRENT vs. BATTERY VOLTAGE (DC CHARGING MODE)



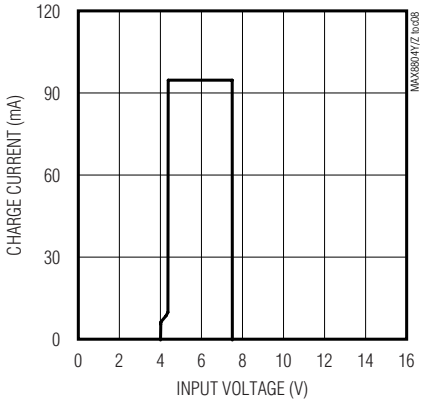
CHARGE CURRENT vs. BATTERY VOLTAGE (USB CHARGING MODE)



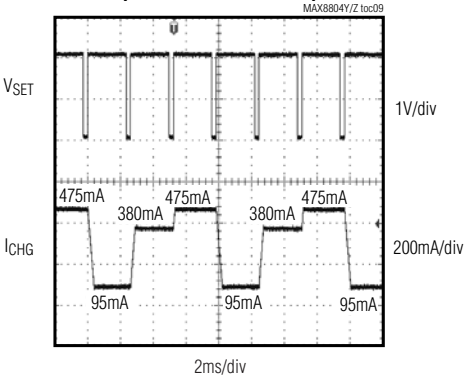
CHARGE CURRENT vs. DC INPUT VOLTAGE



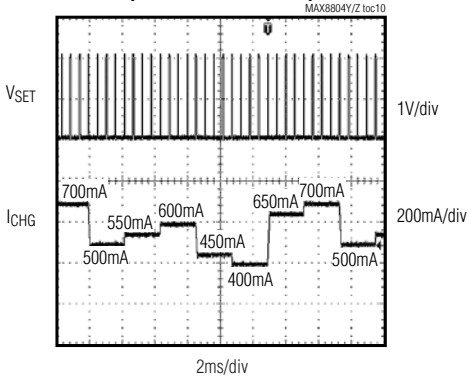
CHARGE CURRENT vs. USB INPUT VOLTAGE



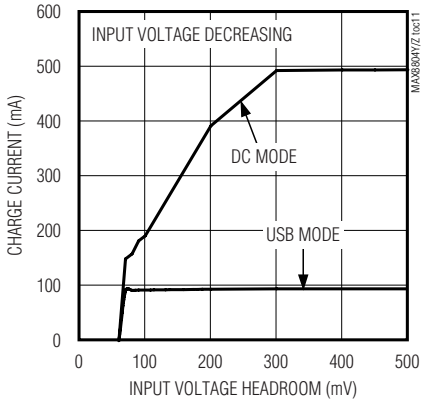
CHARGE CURRENT vs. SET PULSE (USB CHARGING MODE)



CHARGE CURRENT vs. SET PULSE (DC CHARGING MODE)



CHARGE CURRENT vs. INPUT VOLTAGE HEADROOM

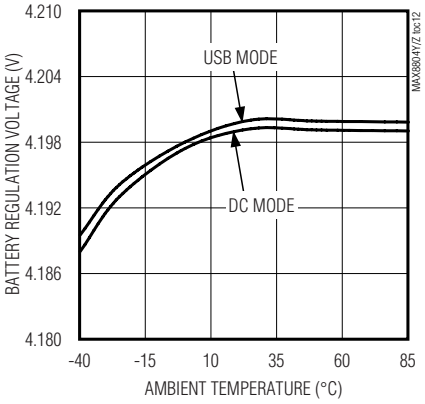


High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

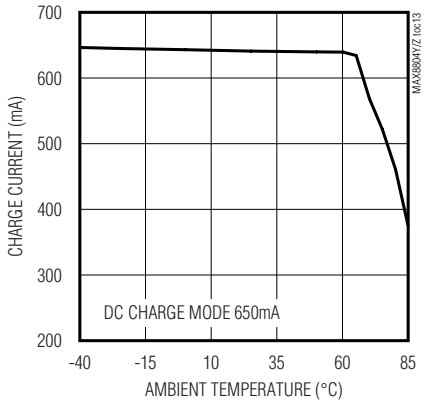
Typical Operating Characteristics (continued)

(V_{BAT} = 3.6V; DC charge mode: V_{DC} = 5V, V_{USB} = 0V, V_{SET} = 0V or unconnected; USB charge mode: V_{USB} = 5V, V_{DC} = 0V, V_{SET} = 5V; T_A = +25°C, unless otherwise noted.)

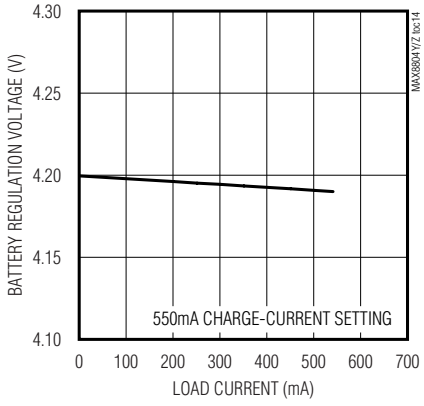
BATTERY REGULATION VOLTAGE vs. AMBIENT TEMPERATURE



CHARGE CURRENT vs. AMBIENT TEMPERATURE



BATTERY REGULATION VOLTAGE vs. LOAD CURRENT



Pin Description

PIN	NAME	FUNCTION
1	BAT	Battery Connection. The IC delivers charging current and monitors battery voltage using BAT. Bypass BAT to GND with a 2.2µF or larger ceramic capacitor. BAT is high impedance when the IC is disabled.
2	$\overline{\text{USBPWR}}$	USB Power Status Output. $\overline{\text{USBPWR}}$ is internally pulled low if a valid voltage is present at USB, otherwise it is high impedance. $\overline{\text{USBPWR}}$ circuitry is active regardless of SET and charger on/off status.
3	$\overline{\text{POK}}$	Power-OK Monitor. $\overline{\text{POK}}$ is an open-drain output that is internally pulled low when a valid charging source is detected at either DC or USB. $\overline{\text{POK}}$ is high impedance when both input voltages are less than V_{UVLO} or V_{BAT}.
4	DC	DC Input Supply. Connect DC to a 4.15V to 7V charging source. Bypass DC to GND with a 1µF or larger ceramic capacitor. DC takes priority over USB when both are valid.
5	USB	USB Input Source. Connect USB to a USB port. Bypass USB to GND with a 1µF or larger ceramic capacitor.
6	$\overline{\text{CHG}}$	Charging-Status Output. $\overline{\text{CHG}}$ is internally pulled low when the battery is being charged. $\overline{\text{CHG}}$ is high impedance when the charger is in top-off mode or disabled.
7	SET	Enable/Disable, Charging Current, and Top-Off Threshold Set Input. Drive SET low to enable DC charge mode and drive high to enable USB charge mode. If both DC and USB inputs are present, SET is used for the DC charge mode only and USB charge is disabled. SET is also used for programming the charge current and top-off threshold. See the *DC/USB Mode and Charging Current Setting* section for details.
8	GND	Ground
—	EP	Exposed Paddle. Connect to the GND plane for optimum thermal dissipation.

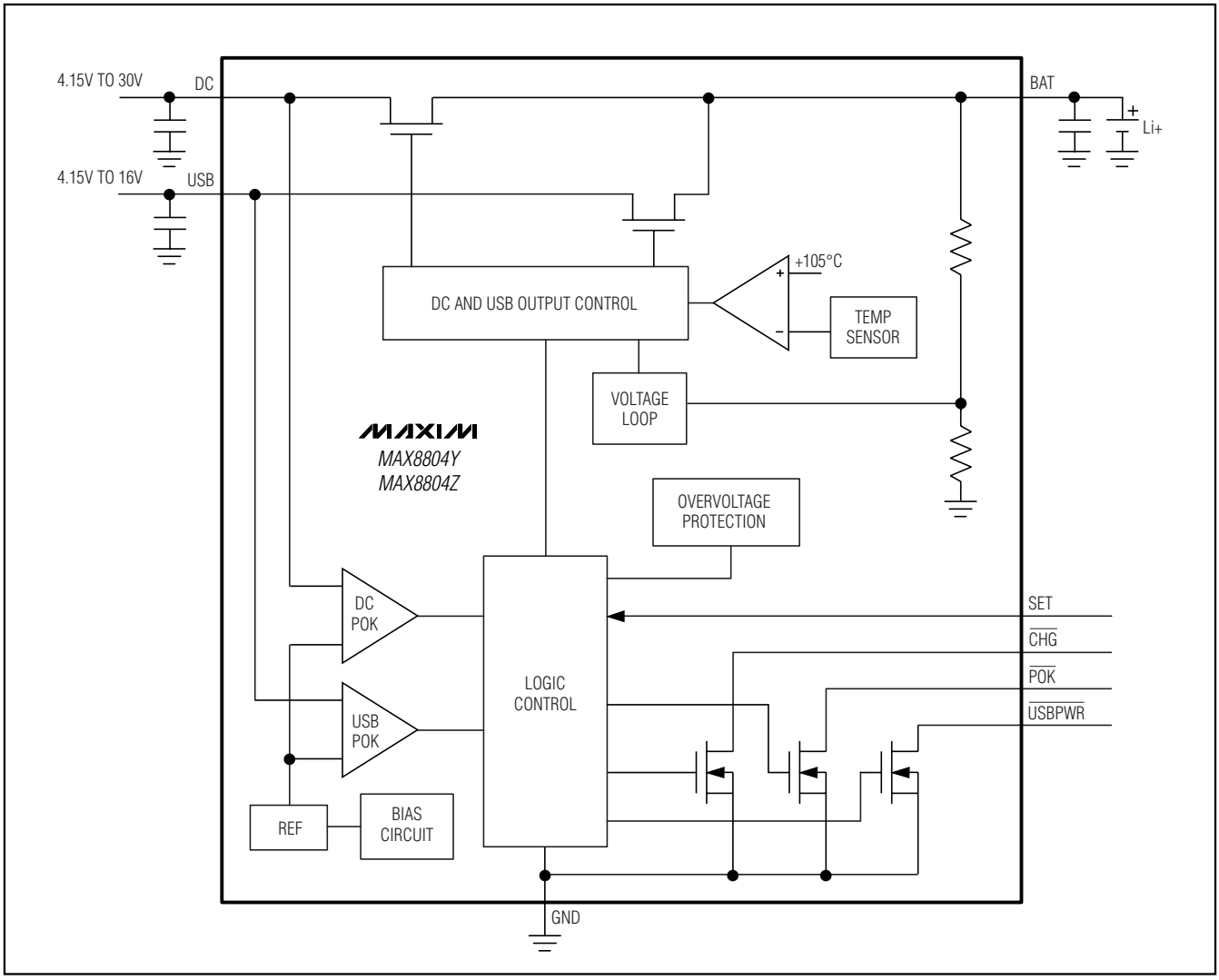


Figure 1. Functional Diagram

Detailed Description

The MAX8804Y/MAX8804Z dual-input linear battery chargers use voltage, current, and thermal-control loops to charge and protect a single Li+ battery. When a Li+ battery with a cell voltage below 2.5V is inserted, the MAX8804Z charger enters the prequalification stage where it precharges that cell with 95mA (Figure 2). The $\overline{CHG}$ indicator output is driven low to indicate entry into the prequalification state. When battery voltage exceeds 2.5V, the charger soft-starts as it enters the fast-charge stage. The MAX8804Y eliminates the prequalification state and enters fast-charge when the battery is inserted. In the MAX8804Y/MAX8804Z, the fast-charge current level is programmed by a simple single-wire interface. As the battery voltage approaches 4.2V, the charging current is reduced. If the battery current drops below the top-off current threshold, the $\overline{CHG}$ indicator goes high impedance, signaling that the battery is fully charged. The ICs then enter a constant voltage-regulation mode to maintain the battery at full charge.

The MAX8804Y/MAX8804Z automatically select between either a USB or AC adapter input source. The AC adapter charge current is programmable from 400mA to 700mA in 50mA steps through a simple single-wire interface. The USB charge current is programmable to 95mA, 380mA, or 475mA through the same interface.

High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

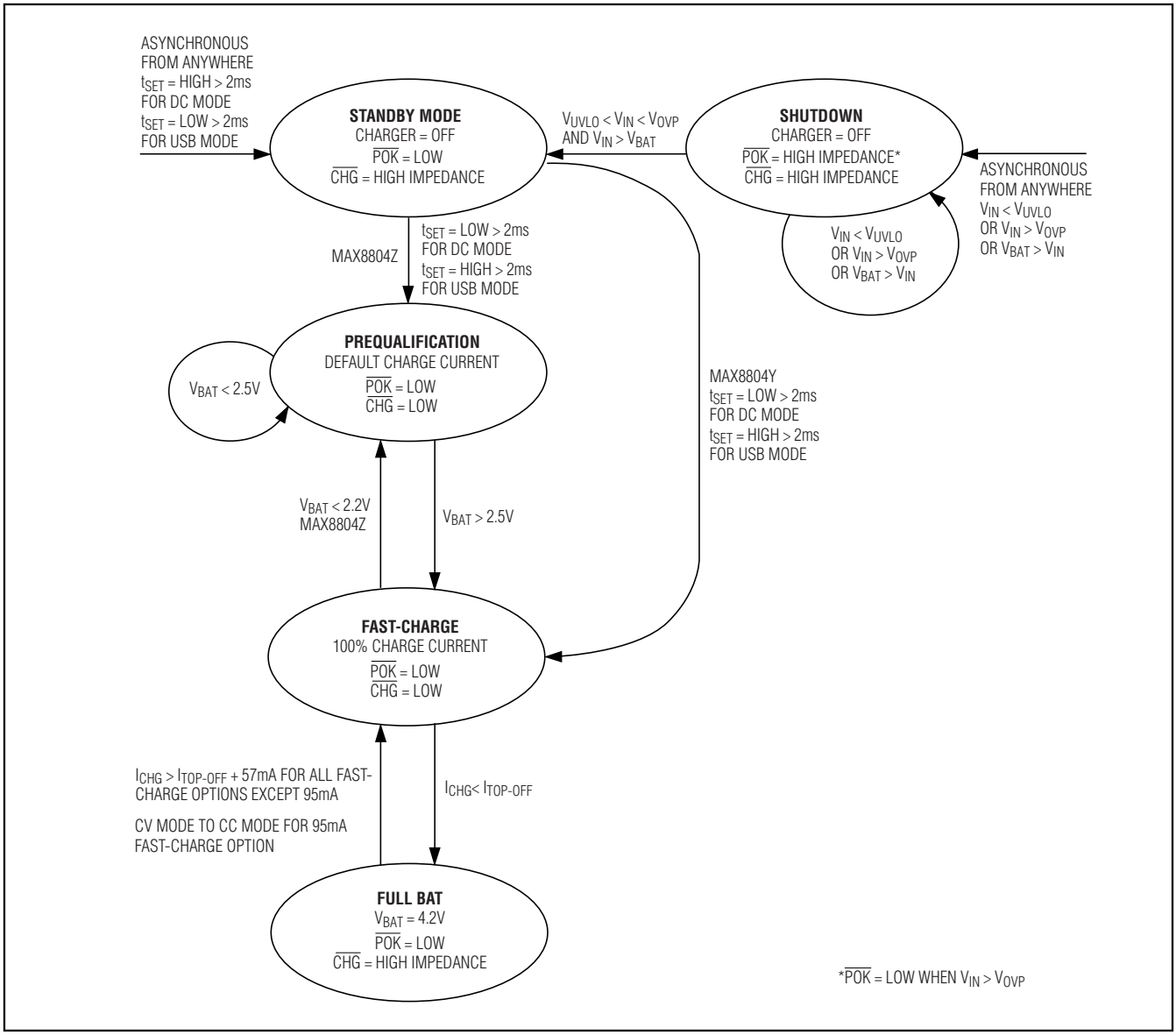


Figure 2. Charger State Diagram

DC Charging

The MAX8804Y/MAX8804Z are designed to charge a single-cell Li+ battery from a DC source voltage between 4.15V and 7V and withstand up to 30V maximum input voltage. The charge current and top-off threshold are programmed with the SET input.

USB Charging

The MAX8804Y/MAX8804Z contain a USB input that allows operation from a USB port with voltages between 4.15V and 7V and can withstand up to 16V maximum input voltage. Pulsing SET allows programming a 95mA, 380mA, or 475mA maximum charging current when using the USB input.

Table 1. SET Truth Table

SET	V_{DC}	V_{USB}	CHARGER STATUS
0	Invalid	Invalid	Off
0	Invalid	Valid	Off
0	Valid	Invalid	DC charging mode enabled, USB charging mode disabled
0	Valid	Valid	DC charging mode enabled, USB charging mode disabled
1	Invalid	Invalid	Off
1	Invalid	Valid	DC charging mode disabled, USB charging mode enabled
1	Valid	Invalid	Off
1	Valid	Valid	Off

DC/USB Mode and Charging Current Setting

SET is a logic input that sets DC/USB charging mode and charging current. Drive SET low or leave it unconnected to enable DC charging mode. Drive SET high to enable USB charging mode (see Table 1). SET can also be driven by series pulses to program the charging current in both DC and USB mode.

DC Charge Mode

Drive SET low or leave it unconnected to enable DC charging mode. Subsequent pulses on SET program the charging current and the top-off threshold. There are seven fast-charge current options and four top-off threshold options. Default fast-charge current and top-off threshold current are 500mA and 80mA. Pulse SET high (1µs to 1ms pulse width) subsequently to realize charging current and top-off threshold programming and transition. After the 28th pulse, the MAX8804Y/MAX8804Z go into the default mode and start a new cycle. See Table 2 and Figure 3 to set the desired charging current and top-off threshold. Drive SET high longer than 2ms to disable DC charging-control circuitry.

Table 2. DC Charging Current Programming by Series Pulses

PULSE NUMBER	DEFAULT	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
I_{CHG} (mA)	500	500	500	500	550	550	550	550	600	600	600	600	450	450	450
Top-Off Current Threshold (mA)	80	90	100	70	80	90	100	70	80	90	100	70	80	90	100
PULSE NUMBER	**—**	**15th**	**16th**	**17th**	**18th**	**19th**	**20th**	**21st**	**22nd**	**23rd**	**24th**	**25th**	**26th**	**27th**	**28th**
I_{CHG} (mA)	—	450	400	400	400	400	650	650	650	650	700	700	700	700	500
Top-Off Current Threshold (mA)	—	70	80	90	100	70	80	90	100	70	80	90	100	70	80

High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

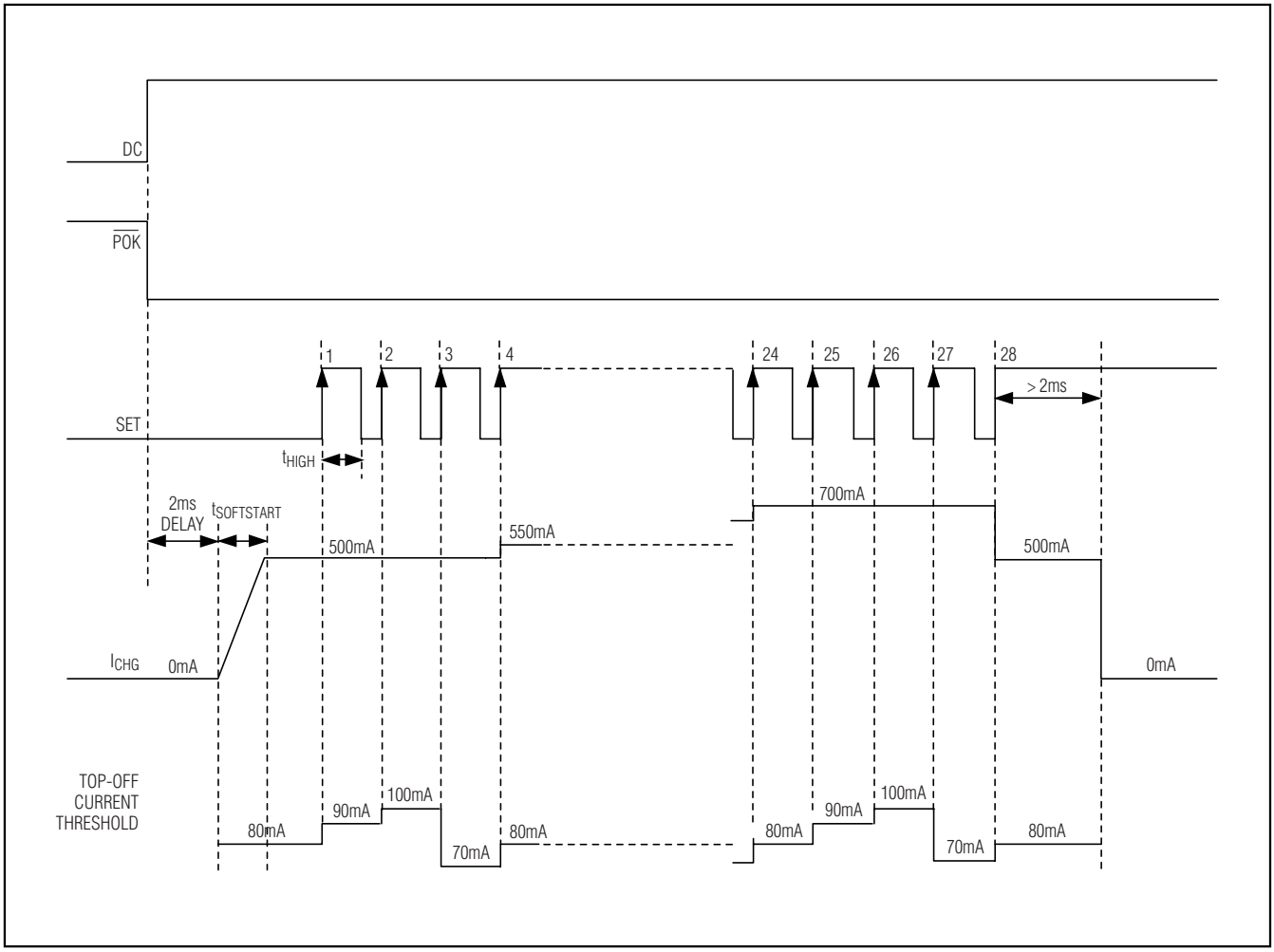


Figure 3. DC Charging Current and Top-Off Threshold Programming

USB Charge Mode

Drive SET high to enable USB charging mode when the USB input is valid. Subsequent low pulses with 1µs to 1ms pulse width on SET program the fast charging current from 95mA, 380mA, to 475mA and then repeat new cycle as shown in Table 3. Drive SET low or leave it unconnected longer than 2ms to disable USB charging-control circuitry.

Table 3. USB Charging Current Programming by Series Pulses

PULSE NUMBER	DEFAULT	1st	2nd	3rd
I_{CHG} (mA)	95	380	475	95
Top-Off Current Threshold (mA)	80	80	80	80

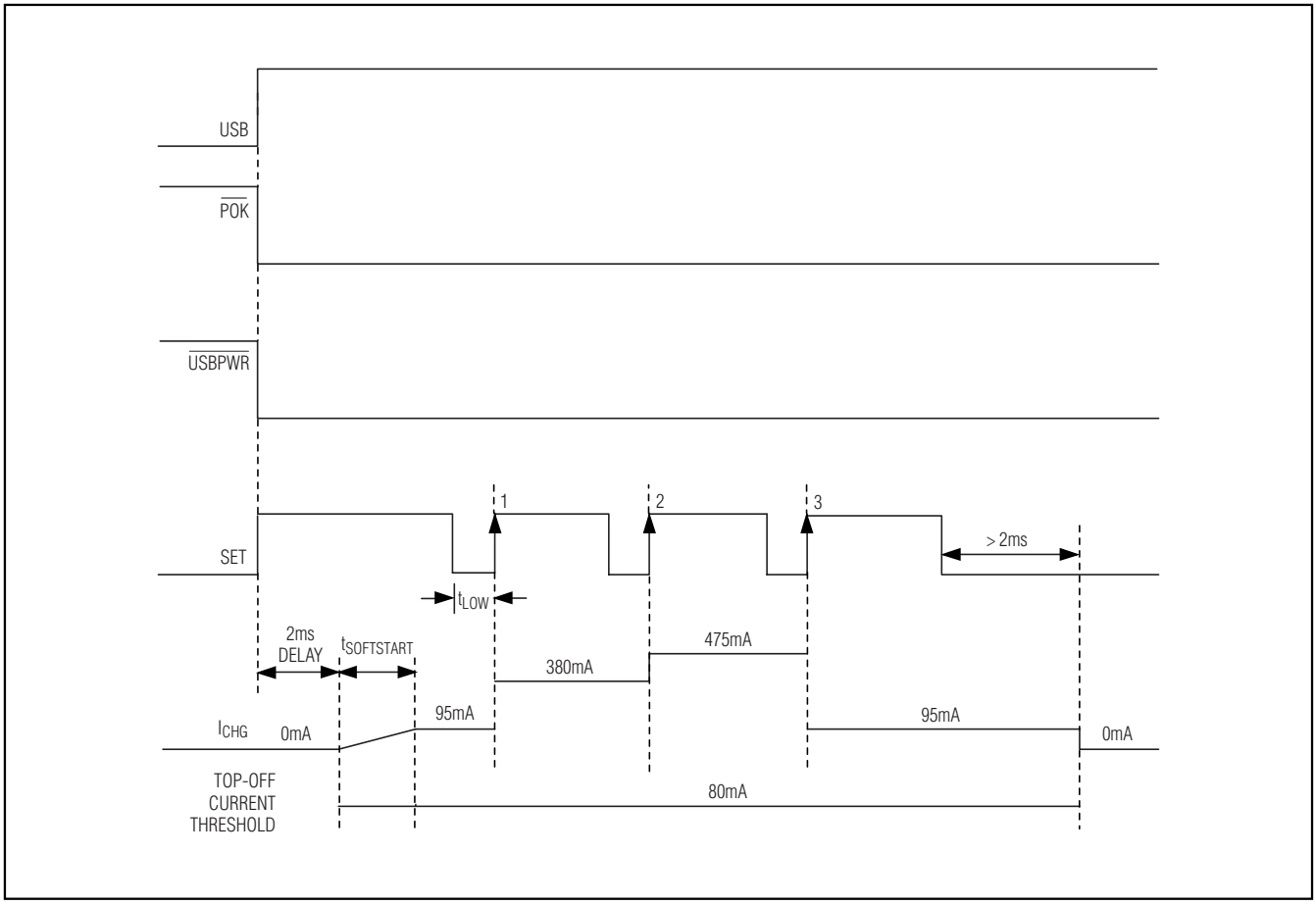


Figure 4. USB Charging Current Programming

Soft-Start

The soft-start circuitry activates when entering fast-charge mode. In the MAX8804Y, soft-start is entered directly after being enabled, and the charging current ramps up in 250µs from 0 to 500mA (95mA in USB mode). This reduces the inrush current on the input supply. Note that the MAX8804Z has a prequalification state and the charging current ramps up when the prequalification state is complete (V_{BAT} exceeds 2.5V).

Thermal Regulation Control

The thermal-regulation loop limits the MAX8804Y/MAX8804Z die temperature to +105°C by reducing the charge current as necessary. This feature not only protects the ICs from overheating, but also allows a higher charge current at room temperature without risking damage to the system.

Charging-Status Output ($\overline{CHG}$)

$\overline{CHG}$ is an open-drain output that indicates charger status. $\overline{CHG}$ goes low during charge cycles where the MAX8804Y/MAX8804Z are in prequalification or fast-charge mode. $\overline{CHG}$ goes high impedance when the charge current reaches the top-off threshold for more than 4ms, indicating charging is done. The $\overline{CHG}$ status is latched after the top-off threshold is reached. The latch is reset by toggling the SET input, recycling input power, or increasing the charging current to the top-off threshold plus 57mA (typ).

When the MAX8804Y/MAX8804Z are used in conjunction with a microprocessor (µP), connect a pullup resistor between $\overline{CHG}$ and the logic I/O voltage to indicate charge status to the µP. Alternatively, $\overline{CHG}$ can sink up to 5mA for an LED charge indicator.

High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

Power-OK Monitor ($\overline{POK}$)

The MAX8804Y/MAX8804Z contain an open-drain $\overline{POK}$ output that goes low when a valid input source is detected at either DC or USB. A valid input source is one whose voltage is greater than 4.15V and exceeds the battery voltage by 250mV. After a valid input has been established, charging is sustained with inputs as low as 3.5V as long as the input voltage remains above the battery voltage by at least 40mV. $\overline{POK}$ status is maintained regardless of SET status.

When the MAX8804Y/MAX8804Z are used in conjunction with a µP, connect a pullup resistor between $\overline{POK}$ and the logic I/O voltage to indicate power-OK to the µP. Alternatively, $\overline{POK}$ can sink up to 5mA for an LED power-OK indicator.

USB Power Status Output ($\overline{USBPWR}$)

$\overline{USBPWR}$ is internally pulled low when $V_{USB} > V_{UVLO}$ and $V_{USB} - V_{BAT} > 250mV$. Otherwise, it is high impedance. $\overline{USBPWR}$ indicates the USB input presence regardless of SET status and charger status.

When the MAX8804Y/MAX8804Z are used in conjunction with a µP, connect a pullup resistor between $\overline{USBPWR}$ and the logic I/O voltage to indicate USB power status to the µP. Alternatively, $\overline{USBPWR}$ can sink up to 5mA for an LED USB power status indicator.

Applications Information

Capacitor Selection

Connect a 2.2µF ceramic capacitor from BAT to GND for proper stability. Connect a 1µF ceramic capacitor from DC to GND. If using the USB input, bypass USB to GND with a 1µF ceramic capacitor. Use a larger input bypass capacitor for high charging currents to reduce supply noise. All capacitors should be X5R dielectric or better. Be aware that some capacitors have large voltage and temperature coefficients and should be avoided.

Thermal Considerations

The MAX8804Y/MAX8804Z are available in a thermally enhanced TDFN package with an exposed paddle. Connect the exposed paddle to a large copper ground plane to provide a thermal contact between the device and the PCB for increased power dissipation. The exposed paddle transfers heat away from the device, allowing the IC to charge the battery with maximum current, while minimizing the die temperature increase.

Input Sources

The MAX8804Y/MAX8804Z operate from well-regulated input sources. The operating input voltage range is 4.15V to 7V. The device survives DC input supply voltages up to 30V and USB input source voltages up to 16V without damage to the IC. If the input voltage is greater than 7.5V (typ), the IC stops charging. An appropriate power supply must provide at least 4.2V plus the voltage drop across the internal pass transistor when sourcing the desired maximum charging current:

$$V_{IN(MIN)} > 4.2V + I_{CHARGE(MAX)} \times R_{ON}$$

where R_{ON} is the input-to-BAT resistance (typically 0.55Ω for DC or 0.65Ω for USB). Failure to meet this requirement results in an incomplete charge or increased charge time.

Application Circuits

Stand-Alone Li+ Charger

The MAX8804Y/MAX8804Z provide a complete Li+ charging solution. The *Typical Application Circuit* shows the MAX8804Y/MAX8804Z as a stand-alone Li+ battery charger. The LED indicates when either fast-charge or prequalification has begun. When the battery is fully charged, the LED turns off.

Microprocessor-Interfaced Li+ Charger

Figure 5 shows the MAX8804Y/MAX8804Z as a µP-interfaced Li+ battery charger. The µP drives SET to enable/disable DC/USB mode charging. $\overline{CHG}$ can be used to detect the charge status of a battery.

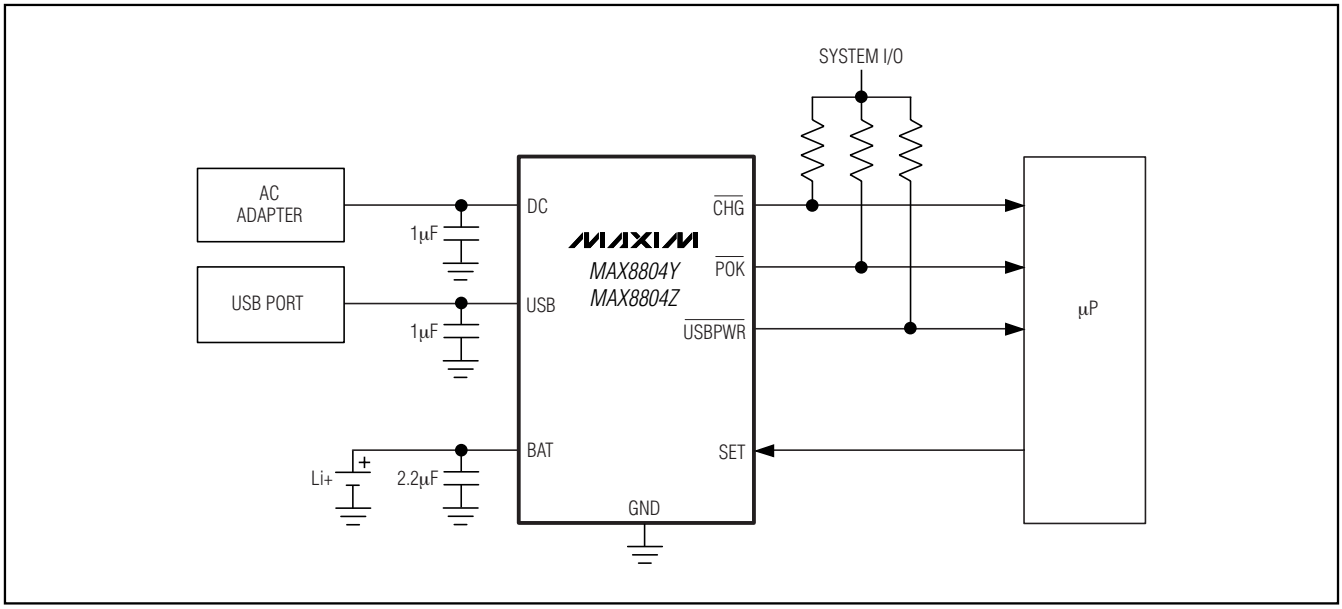


Figure 5. Microprocessor-Interfaced Li+ Charger with the MAX8804Y/MAX8804Z

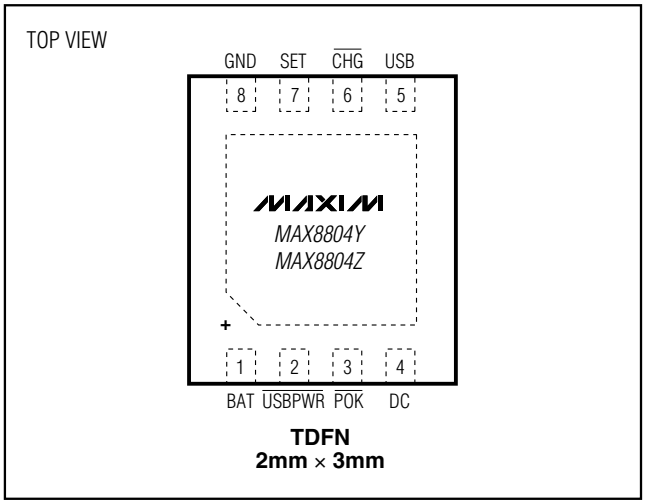
Layout and Bypassing

Connect the input capacitors as close as possible to the IC. Provide a large copper GND plane to allow the exposed paddle to sink heat away from the IC. Connect the battery to BAT as close as possible to the IC to provide accurate battery voltage sensing. Make all high-current traces short and wide to minimize voltage drops. A sample layout is available in the MAX8804Z evaluation kit to speed designs.

Chip Information

PROCESS: BiCMOS

Pin Configuration

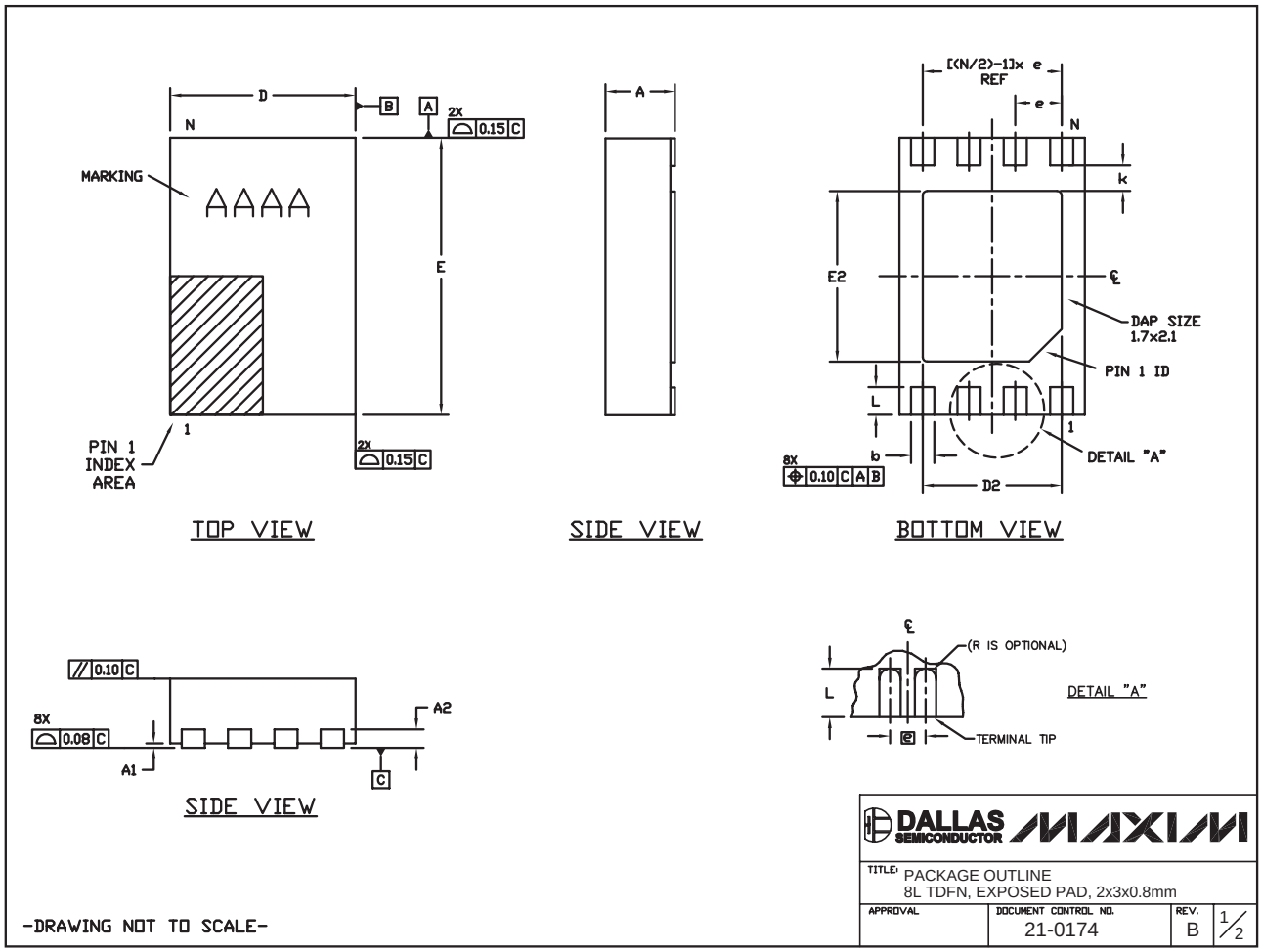


High-Voltage, Dual-Input, USB/AC Adapter Chargers in 2mm x 3mm TDFN

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

8L, TDFN.EPS



Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

	DIMENSIONS		
SYMBOL	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
E	2.95	3.00	3.05
D	1.95	2.00	2.05
A1	0.00	0.02	0.05
L	0.30	0.40	0.50
k	0.20 MIN.		
A2	0.20 REF.		
N	8		
e	0.50 BSC		
b	0.18	0.25	0.30

	EXPOSED PAD PACKAGE					
PKG. CODE	E2			D2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
T823-1	1.60	1.75	1.90	1.50	1.63	1.75

NOTES:
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS. COPLANARITY SHALL NOT EXCEED 0.08mm.
3. WARPAGE SHALL NOT EXCEED 0.10mm.
4. PACKAGE LENGTH/PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S).
5. COMPLY TO JEDEC MO229, TYPE 1, VERSION WCED-2.
6. "N" IS THE TOTAL NUMBER OF LEADS.
7. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
8. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
9. MATERIAL MUST COMPLY WITH BANNED AND RESTRICTED SUBSTANCES SPEC #10-0131.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM

TITLE: PACKAGE OUTLINE
8L TDFN, EXPOSED PAD, 2x3x0.8mm

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0174	B	2/2