19-3795; Rev 1; 12/08

EVALUATION KIT AVAILABLE

MAXIM

USB/AC Adapter, Li+ Linear Battery Charger with Integrated 50mΩ Battery Switch in TDFN

MAX8606

General Description

The MAX8606 complete 1-cell Li+ battery charge-management IC operates from either a USB port or AC adapter. It integrates a battery disconnect switch, current-sense circuit, PMOS pass element, and thermal-regulation circuitry, while eliminating the external reverse-blocking Schottky diode, to create a simple and small charging solution. The charging sequence initiates from power-OK indication, through prequalification, fast-charge, top-off charge, and finally charging-complete indication for single-cell Li+ batteries. Charging is controlled using constant current, constant voltage, or constant die-temperature ($CCCVCT_J$) regulation for safe operation in handhelds.

Two logic inputs ($\overline{EN1}$ and $\overline{EN2}$) select suspend mode, 100mA, 500mA, or ≤1A input current limits to suit USB requirements. Proprietary thermal-regulation circuitry limits the die temperature to +100°C to prevent excessive heat on the system PC board. Additional safety features include an NTC thermistor input (THM) and internal timers to protect the battery. A 3.5V to 4.2V SYS output, in conjunction with the low-R_{DSON} battery switch, powers the system even when the battery is deeply discharged or not installed. The IC also offers a +3.3V/500µA output (VL), a charging status flag ($\overline{CHG}$), and an input-supply detection flag ($\overline{POK}$). The MAX8606 operates from a +4.25V to +5.5V supply and includes undervoltage lockout below +3.4V and overvoltage protection up to +14V.

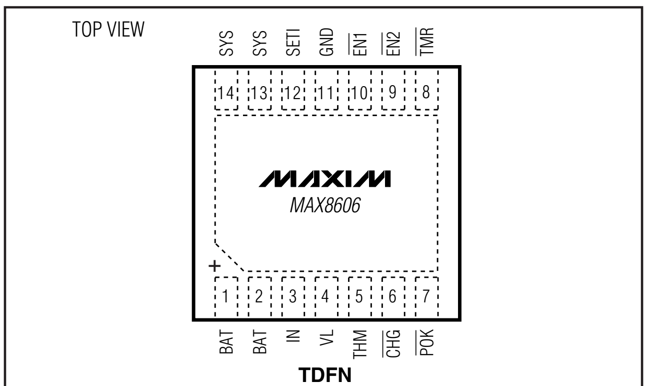
Applications

Cellular Phones, Smartphones, PDAs

Digital Cameras, MP3 Players

USB Appliances, Charging Cradles and Docks

Pin Configuration



Features

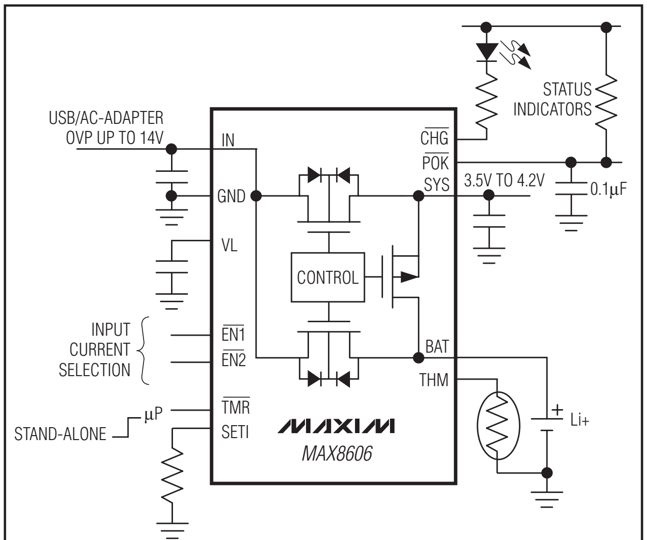
- ♦ Small 3mm x 3mm Thermally Enhanced TDFN Package (0.8mm max height)
- ♦ USB-Compliant Suspend Mode (20µA)
- ♦ Selectable 100mA, 500mA, and Up to 1A Input Current Limits
- ♦ USB or AC Adapter Input
- ♦ +6V to +14V Input Overvoltage Protection
- ♦ Input UVLO Below +4V Rising (3.5V Falling)
- ♦ Automatic Current Sharing Between Battery Charging and System
- ♦ Die Temperature Regulation (+100°C)
- ♦ Prequal, Fast-Charge, and Top-Off Timers
- ♦ Low Dropout Voltage, 250mV at 0.5A
- ♦ NTC Thermistor Input
- ♦ Charge Status and Input-Supply Detection Flags

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX8606ETD+	-40°C to +85°C	14 TDFN 3mm x 3mm (T1433-1)	AAF

+Denotes lead-free/RoHS-compliant package.

Typical Operating Circuit



USB/AC Adapter, Li+ Linear Battery Charger with Integrated 50mΩ Battery Switch in TDFN

ABSOLUTE MAXIMUM RATINGS

IN to GND .... -0.3V to +16V
BAT, SYS, $\overline{EN1}$, $\overline{EN2}$, $\overline{POK}$, $\overline{CHG}$, $\overline{TMR}$ to GND.......-0.3V to +6V
VL, SETI, THM to GND ....-0.3V to +4V
SYS to BAT ....-0.3V to +6V
VL to IN..-16V to +0.3V
IN to BAT Current ....1.0A_{RMS}
IN to SYS Current ....1.0A_{RMS}
BAT to SYS Current ....1.0A_{RMS}
BAT Short-Circuit Duration...Continuous

Continuous Power Dissipation (T_A = +70°C)
14-Pin 3mm x 3mm TDFN (derate 24.4mW/°C above +70°C)...1951.2mW
Operating Temperature Range ....-40°C to +85°C
Junction Temperature Range ....-40°C to +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_{IN} = 5.0V, V_{BAT} = 3.3V, $\overline{EN1}$ = $\overline{EN2}$ = GND, R_{SETI} = 23.58kΩ, C_{VL} = 0.1µF, C_{SYS} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
IN						
IN Voltage Range			0		14	V
IN Operating Voltage Range	(Note 2)		4.25		5.50	V
IN Undervoltage Threshold	V_{IN} rising, 500mV hysteresis (typ)		3.9	4.0	4.1	V
IN Overvoltage Threshold	V_{IN} rising, 100mV hysteresis (typ)		5.6	5.8	6.0	V
IN Supply Current	Charging, I_{BAT} = I_{SYS} = 0mA			1.2	3.0	mA
	Suspend, $\overline{EN1}$ = $\overline{EN2}$ = high, I_{VL} = 0mA			20	40	µA
IN to BAT Switch Leakage	V_{IN} = 14V, BAT = GND	T_A = +25°C		0.1	10	µA
		T_A = +85°C		0.5		
SYS						
SYS Regulated Voltage	I_{SYS} = 0mA, V_{BAT} = 3.3V		3.4	3.5	3.6	V
SYS Current Limit	V_{SYS} = 3.3V	$\overline{EN1}$ = low, $\overline{EN2}$ = low	90	95	100	mA
		$\overline{EN1}$ = low, $\overline{EN2}$ = high	450	475	500	
		$\overline{EN1}$ = high, $\overline{EN2}$ = low	675	712	750	
SYS Dropout Voltage (V_{IN} - V_{BAT})	I_{SYS} = 400mA, V_{SYS} = 3.3V, $\overline{EN1}$ = low, $\overline{EN2}$ = high			350	700	mV
SYS Load Regulation	I_{SYS} = 1mA to 675mA, $\overline{EN1}$ = high, $\overline{EN2}$ = low			10		mV
BAT						
BAT Regulation Voltage	I_{BAT} = 0mA	T_A = +25°C	4.18	4.20	4.22	V
		T_A = -40°C to +85°C	4.16	4.20	4.24	
Maximum Charging Current			1			A
BAT Charging Current	$\overline{EN1}$ = low, $\overline{EN2}$ = low	I_{SYS} = 0mA	87	95	100	mA
		I_{SYS} = 50mA		45		
	$\overline{EN1}$ = low, $\overline{EN2}$ = high	I_{SYS} = 0mA	450	475	500	
		I_{SYS} = 250mA		225		
	$\overline{EN1}$ = high, $\overline{EN2}$ = low	I_{SYS} = 0mA	675	712	750	
		I_{SYS} = 375mA		337		

ELECTRICAL CHARACTERISTICS (continued)

(V_{IN} = 5.0V, V_{BAT} = 3.3V, $\overline{EN1}$ = $\overline{EN2}$ = GND, R_{SETI} = 23.58kΩ, C_{VL} = 0.1µF, C_{SYS} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
BAT Prequal Current	V_{BAT} = 2.0V	$\overline{EN1}$ = low, $\overline{EN2}$ = low, I_{SYS} = 0mA	87	95	100	mA
		$\overline{EN1}$ = low, $\overline{EN2}$ = high, I_{SYS} = 0 to 350mA		95		
		$\overline{EN1}$ = high, $\overline{EN2}$ = low, I_{SYS} = 0 to 575mA		95		
Soft-Start Time				1.5		ms
BAT Prequal Threshold	V_{BAT} rising, 150mV hysteresis (typ)		2.9	3.0	3.1	V
BAT Dropout Voltage (V_{IN} - V_{BAT})	V_{BAT} = 4.1V, I_{BAT} = 400mA			200	400	mV
BAT Short-Circuit Current Limit	BAT = GND		70	95	120	mA
BAT to SYS Switch R_{ON}	V_{BAT} = 3.5V, V_{SYS} = 3.4V, V_{IN} = 0V			50	100	mΩ
BAT to SYS Switch Threshold	BAT rising, 160mV hysteresis (typ)		3.4	3.5	3.6	V
Battery-Removal Threshold	BAT rising, 210mV hysteresis (typ)		4.5	4.75	5.0	V
BAT Leakage Current	V_{IN} = 0V	T_A = +25°C		0.1	10	µA
		T_A = +85°C		0.1		
	V_{IN} = 2.4V	T_A = +25°C		0.1	10	
		T_A = +85°C		0.1		
	$\overline{EN1}$ = high, $\overline{EN2}$ = high	T_A = +25°C	-10	0.1	+10	
		T_A = +85°C		0.1		
VL						
VL Output Voltage	I_{VL} = 0 to 500µA		3.1	3.3	3.5	V
VL Shutdown Voltage	$V_{\overline{EN1}}$ = $V_{\overline{EN2}}$ = 5V			0		V
THM						
THM Internal Pullup Resistance				10		kΩ
THM Resistance Threshold, Hot	10% hysteresis		3.72	3.93	4.13	kΩ
THM Resistance Threshold, Cold	10% hysteresis		26.6	28.3	30.0	kΩ
THM Resistance Threshold, Disabled	70% hysteresis		274	305	336	Ω
SETI						
SETI Servo Voltage	$\overline{EN1}$ = low, $\overline{EN2}$ = low			0.28		V
	$\overline{EN1}$ = low, $\overline{EN2}$ = high			1.4		
	$\overline{EN1}$ = high, $\overline{EN2}$ = low			2.1		
SETI Resistance Range			17.68	23.58	35.36	kΩ
$\overline{POK}$						
$\overline{POK}$ Trip Threshold (V_{IN} - V_{BAT})	4.1V < V_{IN} < 5.6V, V_{BAT} = 4.1V	V_{IN} rising	150	250	350	mV
		V_{IN} falling	5	55	125	
$\overline{POK}$ Voltage, Low	$I_{\overline{POK}}$ = 5mA			0.05	0.2	V
$\overline{POK}$ Leakage Current, High	$V_{\overline{POK}}$ = 6V	T_A = +25°C		0.01	1	µA
		T_A = +85°C		0.01		

ELECTRICAL CHARACTERISTICS (continued)

(V_{IN} = 5.0V, V_{BAT} = 3.3V, $\overline{EN1}$ = $\overline{EN2}$ = GND, R_{SETI} = 23.58kΩ, C_{VL} = 0.1µF, C_{SYS} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
$\overline{CHG}$						
Full-Battery Detection Current Threshold	I_{BAT} falling		30	50	70	mA
$\overline{CHG}$ Voltage, Low	$I_{\overline{CHG}}$ = 5mA			0.05	0.02	V
$\overline{CHG}$ Leakage Current, High	$V_{\overline{CHG}}$ = 6V	T_A = +25°C		0.01	1	µA
		T_A = +85°C		0.01		
$\overline{EN1}$, $\overline{EN2}$, $\overline{TMR}$						
Logic Input Leakage Current	$V_{\overline{TMR}}$ = $V_{\overline{EN1}}$ = $V_{\overline{EN2}}$ = 0 to 5.5V	T_A = +25°C		0.01	1	µA
		T_A = +85°C		0.01		
Logic Input Low Voltage					0.4	V
Logic Input High Voltage			1.6			V
THERMAL LIMIT						
Thermal-Regulation Threshold				+100		°C
Thermal-Regulation Gain	T_J to I_{BAT} , T_J > +100°C			-50		mA/°C
TIMER						
Oscillator Accuracy			112	140	168	kHz
Overvoltage Turn-On Delay				800		ms
Prequal Fault Timer			24	30	36	min
Fast-Charge Fault Timer				480		min
Top-Off Timer				30		min
$\overline{CHG}$ Blinking Rate	In fault state, 50% duty		1.68	2.10	2.52	Hz

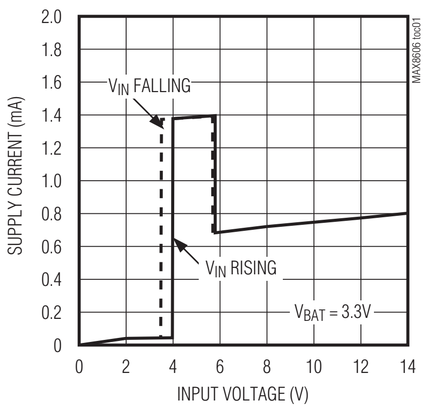
Note 1: Specifications are 100% production tested at T_A = +25°C. Limits over the operating temperature range are guaranteed by design and characterization.

Note 2: Guaranteed by undervoltage and overvoltage threshold testing.

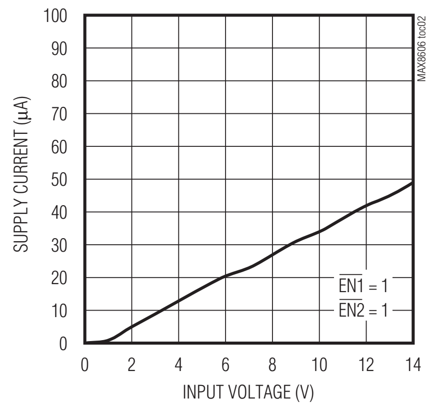
Typical Operating Characteristics

(V_{IN} = +5V, V_{BAT} = 3.6V, I_{SYS} = 0, $\overline{EN1}$ = 1, $\overline{EN2}$ = 0, circuit of Figure 3, T_A = +25°C, unless otherwise noted.)

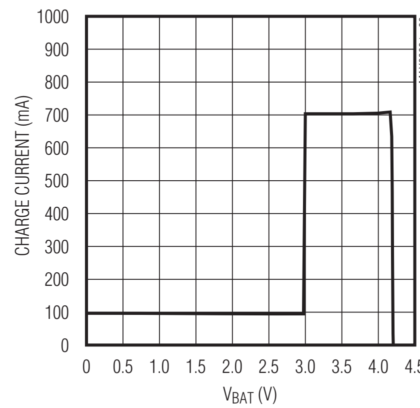
SUPPLY CURRENT vs. INPUT VOLTAGE



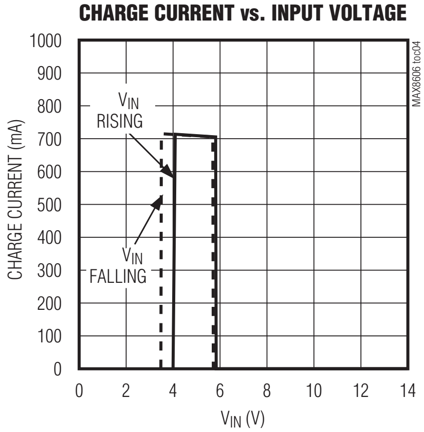
SUSPEND-MODE SUPPLY CURRENT vs. INPUT VOLTAGE



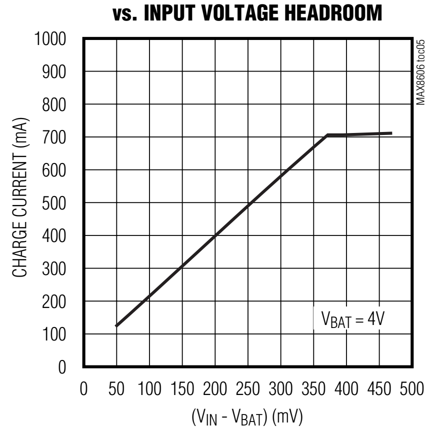
CHARGE CURRENT vs. BATTERY VOLTAGE



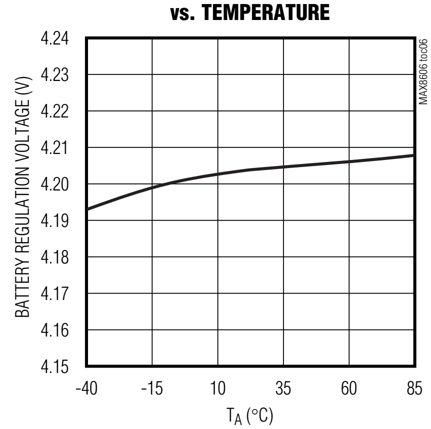
CHARGE CURRENT vs. INPUT VOLTAGE



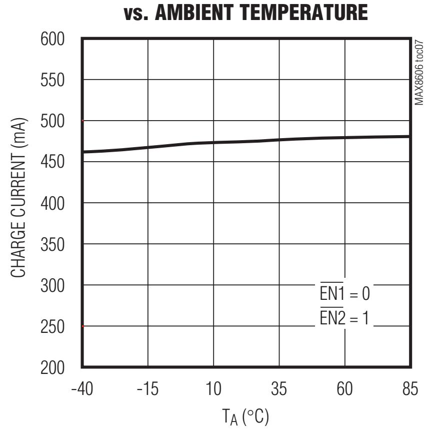
CHARGE CURRENT vs. INPUT VOLTAGE HEADROOM



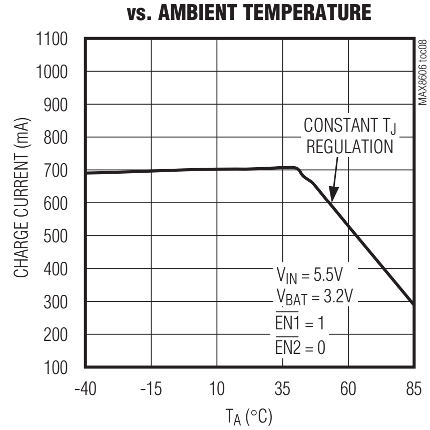
BATTERY REGULATION VOLTAGE vs. TEMPERATURE



CHARGE CURRENT vs. AMBIENT TEMPERATURE



CHARGE CURRENT vs. AMBIENT TEMPERATURE



USB/AC Adapter, Li+ Linear Battery Charger with Integrated 50mΩ Battery Switch in TDFN

Pin Description

PIN	NAME	FUNCTION
1, 2	BAT	Battery Connection. The IC delivers charging current and monitors battery voltage using BAT. Connect both BAT outputs together externally. During suspend mode, BAT is internally connected to SYS.
3	IN	Supply Voltage Input. Connect IN to a 4.25V to 5.5V supply. Charging is suspended if V_{IN} exceeds 6V. Bypass IN to GND with a 4.7µF or larger ceramic capacitor.
4	VL	+3.3V Output Voltage and Logic Supply. VL is regulated to +3.3V and is capable of sourcing 500µA to provide power for external circuits. Bypass VL to GND with a 0.1µF or larger ceramic capacitor. VL is internally pulled to GND during suspend mode.
5	THM	Thermistor Input. Connect a 10kΩ NTC thermistor from THM to GND in close proximity to the battery to monitor the battery temperature. The IC suspends charging when the temperature is outside the hot and cold limits. Connect THM to GND to disable the thermistor monitoring function.
6	$\overline{CHG}$	Charging Status Output. $\overline{CHG}$ is an open-drain output that goes low when the battery is charging. $\overline{CHG}$ goes high impedance when the charge current drops below 50mA (typ) and the battery voltage is 4.2V (typ). $\overline{CHG}$ is high impedance when the IC is in suspend mode.
7	$\overline{POK}$	Power-OK Monitor. $\overline{POK}$ is an open-drain output that pulls low when a valid charging source is detected at IN.
8	$\overline{TMR}$	Timer-Selection Input. Drive $\overline{TMR}$ high to enable the microprocessor mode where the charge times are determined by an external device. Drive $\overline{TMR}$ low to use the internal prequal, fast-charge, and top-off timers.
9	$\overline{EN2}$	Charge-Current Selection Input. Drive $\overline{EN\_}$ high or low to select the charge current or to put the MAX8606 into suspend mode (see Table 1).
10	$\overline{EN1}$	Charge-Current Selection Input. Drive $\overline{EN\_}$ high or low to select the charge current or to put the MAX8606 into suspend mode (see Table 1).
11	GND	Ground. Connect directly to exposed paddle under the IC.
12	SETI	Charge-Current Programming Input. Connect a resistor from SETI to GND to set the maximum charging current. R_{SETI} must be between 17.68kΩ and 35.36kΩ.
13, 14	SYS	System Supply Output. SYS delivers up to $1A_{RMS}$ to power an external system. Bypass SYS to GND with a 4.7µF or larger ceramic capacitor. SYS is connected to BAT through an internal 50mΩ switch when V_{BAT} exceeds 3.5V or when the MAX8606 is in suspend mode.
—	EP	Exposed Paddle. Connect to GND under the IC. Connect to a large ground plane to improve power dissipation.

Detailed Description

The MAX8606 charger uses current, voltage, and thermal control loops to charge and protect a single Li+ battery cell. It can start the system even when the battery is in deep saturation. The MAX8606 provides a SYS output that supplies the external system with a minimum 3.5V at 1A.

Two active-low enable inputs ($\overline{EN1}$ and $\overline{EN2}$) are supplied to set the SYS and charging current limits. During prequal and fast-charge modes, the $\overline{CHG}$ output status flag is pulled low. As the battery voltage approaches 4.2V, the charging current is reduced. When the charging current drops below 50mA and the battery voltage equals 4.2V, the $\overline{CHG}$ output goes high impedance, signaling a full battery. At any time during charging, if both $\overline{EN1}$ and $\overline{EN2}$ are driven high, the charger enters suspend mode, charging stops, and $\overline{CHG}$ goes high impedance.

The MAX8606 contains an internal timer to measure the prequal, fast-charge, and top-off charge time. If the battery voltage has not risen above 3V after 30 minutes or has not completed fast-charge in 8 hours, the charger goes into a fault state where the charging is

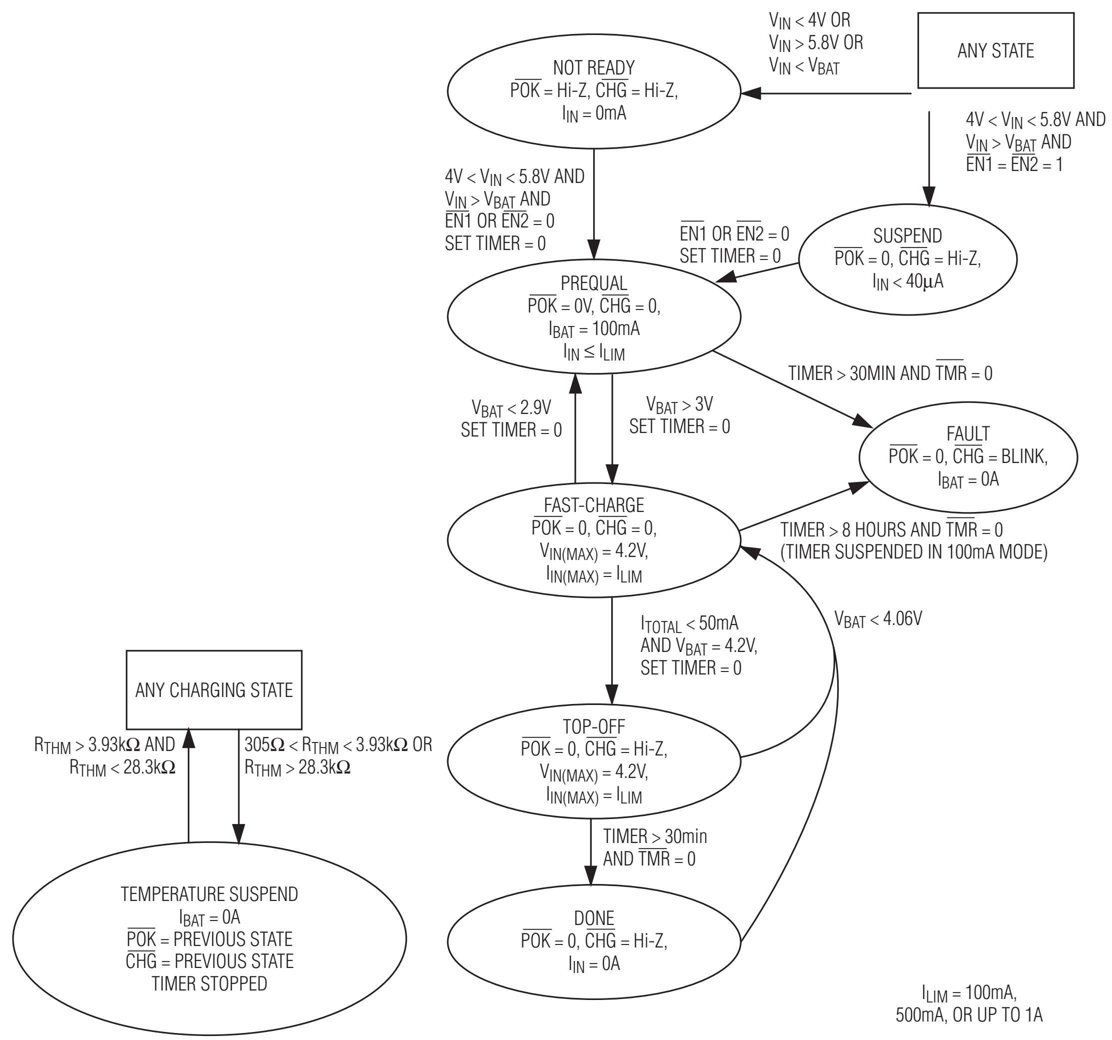


Figure 1. MAX8606 State Diagram

suspended and the $\overline{CHG}$ flag turns on and off at 2Hz. Either the input power must be cycled or the suspend mode enabled to clear the fault.

$\overline{EN1}$ and $\overline{EN2}$ Inputs

$\overline{EN1}$ and $\overline{EN2}$ are logic inputs that enable the charger and select the charging current (see Table 1). Drive $\overline{EN1}$ and $\overline{EN2}$ high to place the IC in suspend mode.

USB/AC Adapter, Li+ Linear Battery Charger with Integrated 50mΩ Battery Switch in TDFN

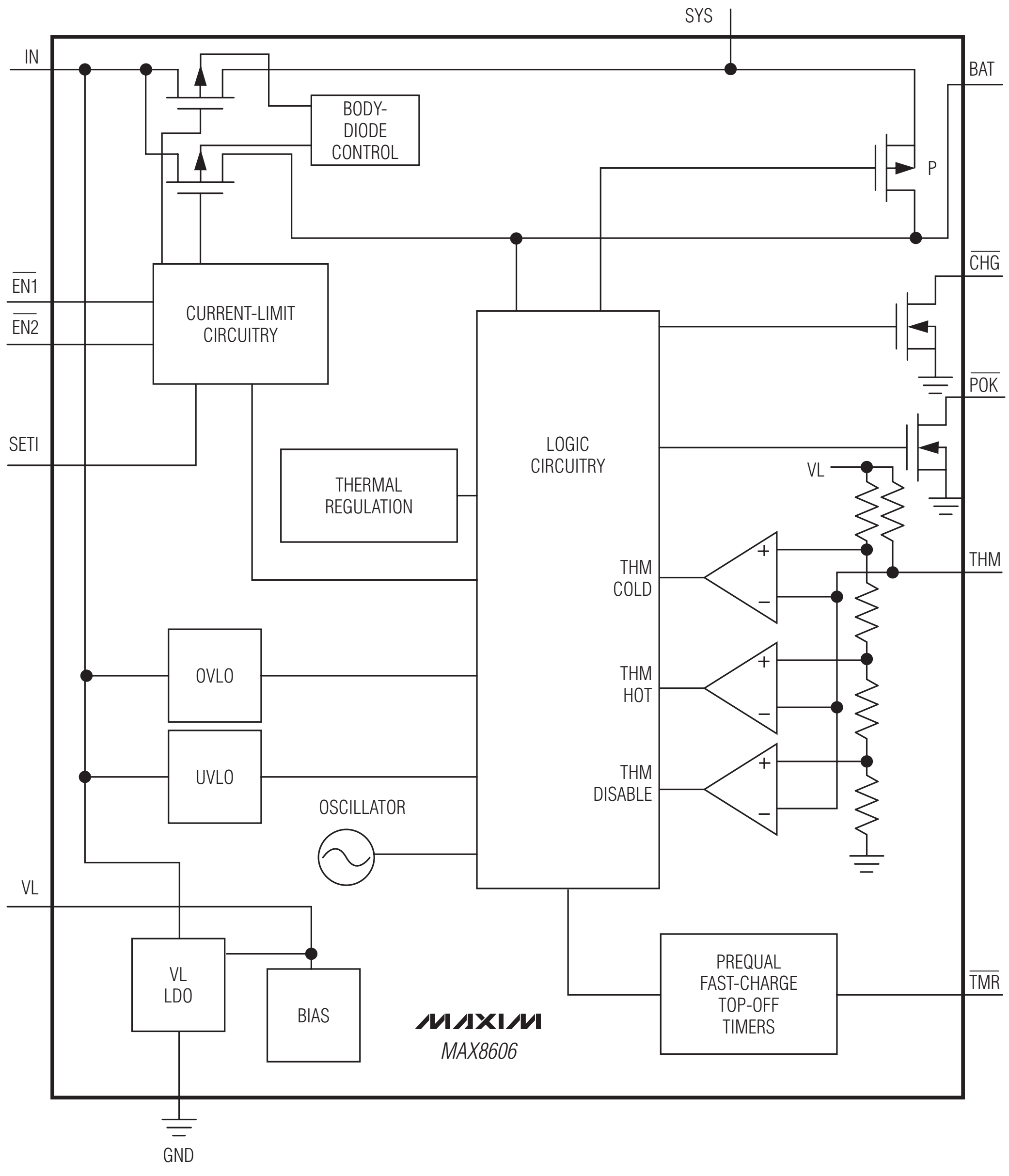


Figure 2. MAX8606 Block Diagram

VL Internal Voltage Regulator

The MAX8606 linear charger contains an internal linear regulator to supply the power for the IC. Bypass VL to GND with a 0.1µF ceramic capacitor. VL is regulated to 3.3V whenever the input voltage is above the battery voltage and can source up to 500µA for external loads.

$\overline{\text{CHG}}$ Charge-Indicator Output

$\overline{\text{CHG}}$ is an open-drain output that indicates charger status and can be used with an LED. $\overline{\text{CHG}}$ goes low during charging. $\overline{\text{CHG}}$ goes high impedance when V_{BAT} equals 4.2V and the charging current drops below 50mA. When the MAX8606 is used in conjunction with a microprocessor (µP), connect a pullup resistor between $\overline{\text{CHG}}$ and the logic I/O voltage to indicate charge status to the µP. $\overline{\text{CHG}}$ also indicates a timer fault. If the internal prequal or fast-charge timer expires without completing the charge cycle, charging is suspended and the $\overline{\text{CHG}}$ output "blinks" at 2.1Hz.

Soft-Start

To prevent input transients, the rate of change of the charge current is limited when the charger is turned on or changes its current compliance. It takes approximately 1ms for the charger to go from 0mA to the maximum fast-charge current.

$\overline{\text{TMR}}$ Input

The MAX8606 includes a 30-minute prequalification fault timer, an 8-hour fast-charge fault timer, and a 30-minute top-off timer to terminate the changing cycle. Drive $\overline{\text{TMR}}$ low to enable the internal timers. Drive $\overline{\text{TMR}}$ high to disable the internal timers and allow an external device to determine charge times.

THM Input

The MAX8606 monitors the battery temperature with an external NTC thermistor that is in close thermal contact with the battery. Select a thermistor resistance that is 10kΩ at +25°C and has a beta of 3500 Kelvins. The IC compares the resistance from THM to GND and suspends charging when it is greater than 28.3kΩ or less than 3.93kΩ, which translates to a battery temperature of 0°C or +50°C, respectively. Connect THM to GND to disable the temperature control function.

SYS Output

The MAX8606 contains a SYS output that delivers up to $1A_{RMS}$ at 3.5V to 4.2V to power an external system. Bypass SYS to GND with a 4.7µF or larger ceramic capacitor. When V_{BAT} exceeds 3.5V or when the MAX8606 is in suspend mode, the MAX8606 internally connects SYS to BAT through a 50mΩ switch. When charging a battery, the load on SYS is serviced first and the remaining available current goes to charge the battery. SYS is connected to BAT when V_{IN} is not valid.

Table 1. $\overline{\text{EN1}}$ and $\overline{\text{EN2}}$ Control

$\overline{\text{EN1}}$	$\overline{\text{EN2}}$	MODE
0	0	100mA
0	1	500mA
1	0	8000 x 2.1V / R_{SETI}
1	1	Suspend

$\overline{\text{POK}}$

The MAX8606 contains an open-drain $\overline{\text{POK}}$ output that goes low when a valid input source is detected at IN. A valid input source is one whose voltage is between 4V and 5.8V 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 55mV. $\overline{\text{POK}}$ is high impedance otherwise.

Applications Information

Charge-Current Selection

For USB applications, the charging current is internally limited to 100mA or 500mA. For wall-cube applications requiring a different current requirement, set the charging current with an external resistor from SETI to GND (R_{SETI}). Calculate R_{SETI} as follows:

$$R_{SETI} = 8000 \times 2.1V / (I_{BAT} + I_{SYS})$$

where $\overline{\text{EN1}}$ = high and $\overline{\text{EN2}}$ = low.

The SETI input also enables the user to monitor the charging current. Under fast-charge operation, the SETI voltage regulates to 1.4V ($\overline{\text{EN1}}$ low and $\overline{\text{EN2}}$ high) or 2.1V ($\overline{\text{EN1}}$ high and $\overline{\text{EN2}}$ low). As the charging current decreases, V_{SETI} decreases. This is due to either the thermal regulation control or voltage regulation control (4.2V) of the MAX8606. V_{SETI} is calculated using the following equation:

$$V_{SETI} = (I_{BAT} + I_{SYS}) \times R_{SETI} / 8000$$

Thermal Regulation

The MAX8606 features a thermal limit that reduces the charge current when the die temperature exceeds +100°C. As the temperature increases, the IC lowers the charge current by 50mA/°C above +100°C.

Capacitor Selection

Connect a ceramic capacitor from SYS to GND as close to the IC as possible for proper stability. Use a 4.7µF X5R ceramic capacitor for most applications.

Connect a 4.7µF ceramic capacitor from IN to GND as close to the IC as possible. Use a larger input bypass capacitor to reduce supply noise.

Thermal Considerations

The MAX8606 is available in a thermally enhanced TDFN package with exposed paddle. Connect the exposed paddle to a large copper ground plane to provide a good thermal contact between the device and the circuit board. The exposed paddle transfers heat away from the device, allowing the MAX8606 to charge the battery with maximum current while minimizing the increase in die temperature.

DC Input Sources

The MAX8606 operates from well-regulated DC sources. The full-charging input voltage range is 4.25V to 5.8V. The device survives input voltages up to 14V without damage to the IC. If V_{IN} is greater than 5.8V (typ), the IC stops charging. An appropriate power supply must provide at least 4.25V when sourcing the desired peak charging current. It also must stay below 5.8V when unloaded.

Application Circuits

Stand-Alone Li+ Charger

The MAX8606 provides a complete Li+ charging solution. Figure 3 shows the MAX8606 as a stand-alone Li+ battery charger. The 23.58kΩ resistor connected to SETI sets a charging current of 712mA (typ). The LED indicates when either prequal or fast-charging has begun. When the battery is charged the LED turns off.

USB Application with AC Adapter

The MAX8606 can be configured for USB applications with an optional AC-adapter input (Figure 4). The p-channel MOSFET disconnects the USB port when the AC adapter is installed. Alternately, the USB port and AC adapter may be excluded from each other by mechanical means, such as using a single connector.

USB-Powered Li+ Charger

The universal serial bus (USB) provides a high-speed serial communication port, as well as power for the remote device. The MAX8606 can be configured to charge a battery at the highest current possible from the host port. Figure 5 shows the MAX8606 as a USB battery charger. To make the circuit compatible with either 100mA or 500mA USB ports, the system software begins at 100mA charging current. The microprocessor then enumerates with the host to determine its current capability. If the host port is capable, the charging current is increased to 475mA to avoid exceeding the 500mA USB specification.

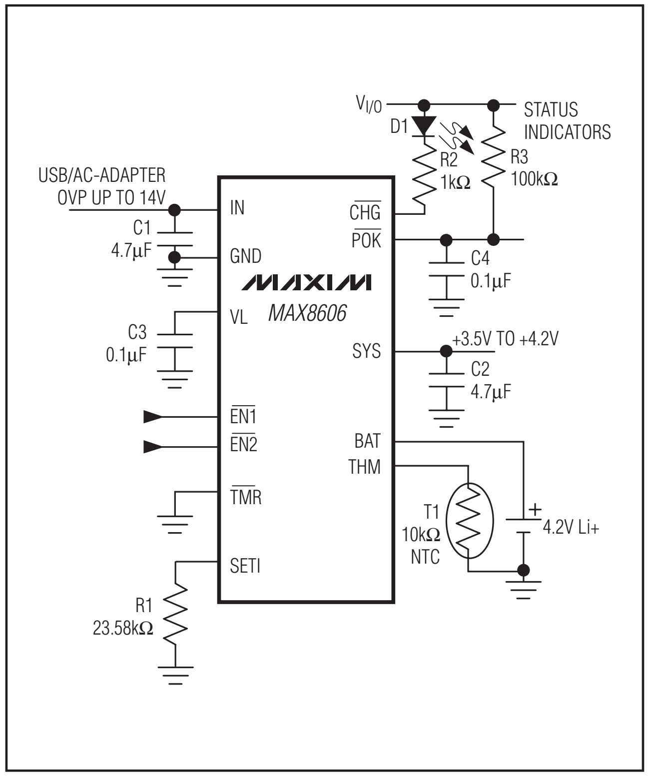


Figure 3. Stand-Alone Application

Layout and Bypassing

Place the input capacitor as close to the device as possible. Provide a large copper ground plane to allow the exposed paddle to sink heat away from the device. Connect the battery to BAT as close to the device as possible 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 MAX8606 evaluation kit to help speed designs.

Chip Information

PROCESS: BiCMOS

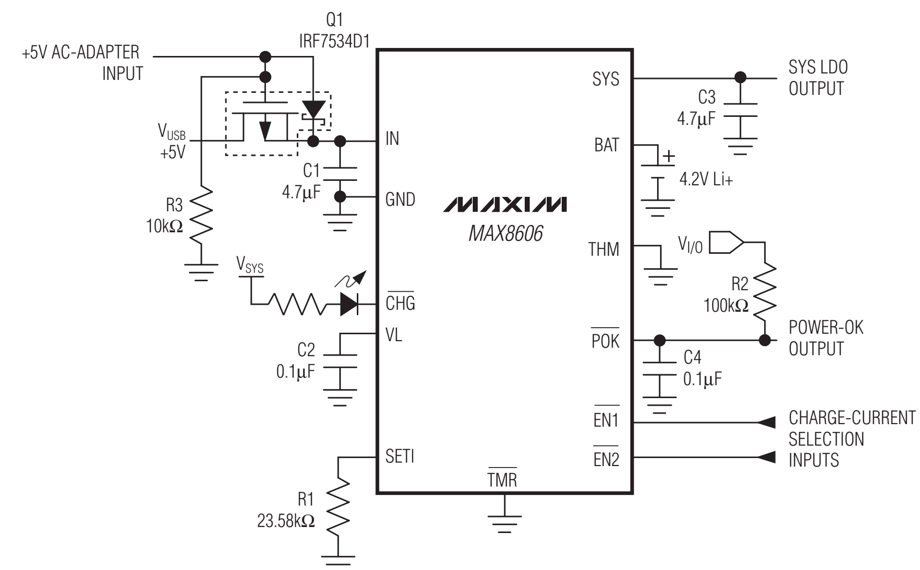


Figure 4. USB Application with AC Adapter

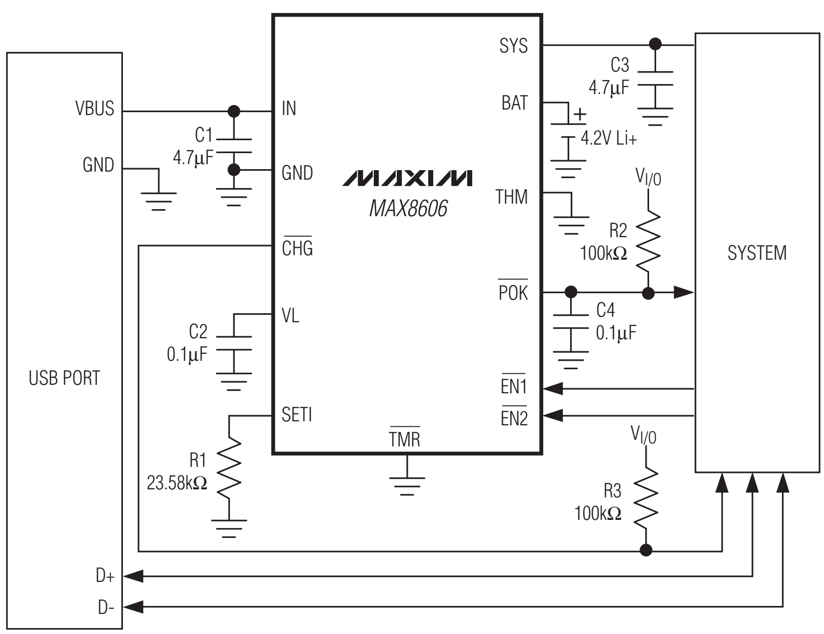


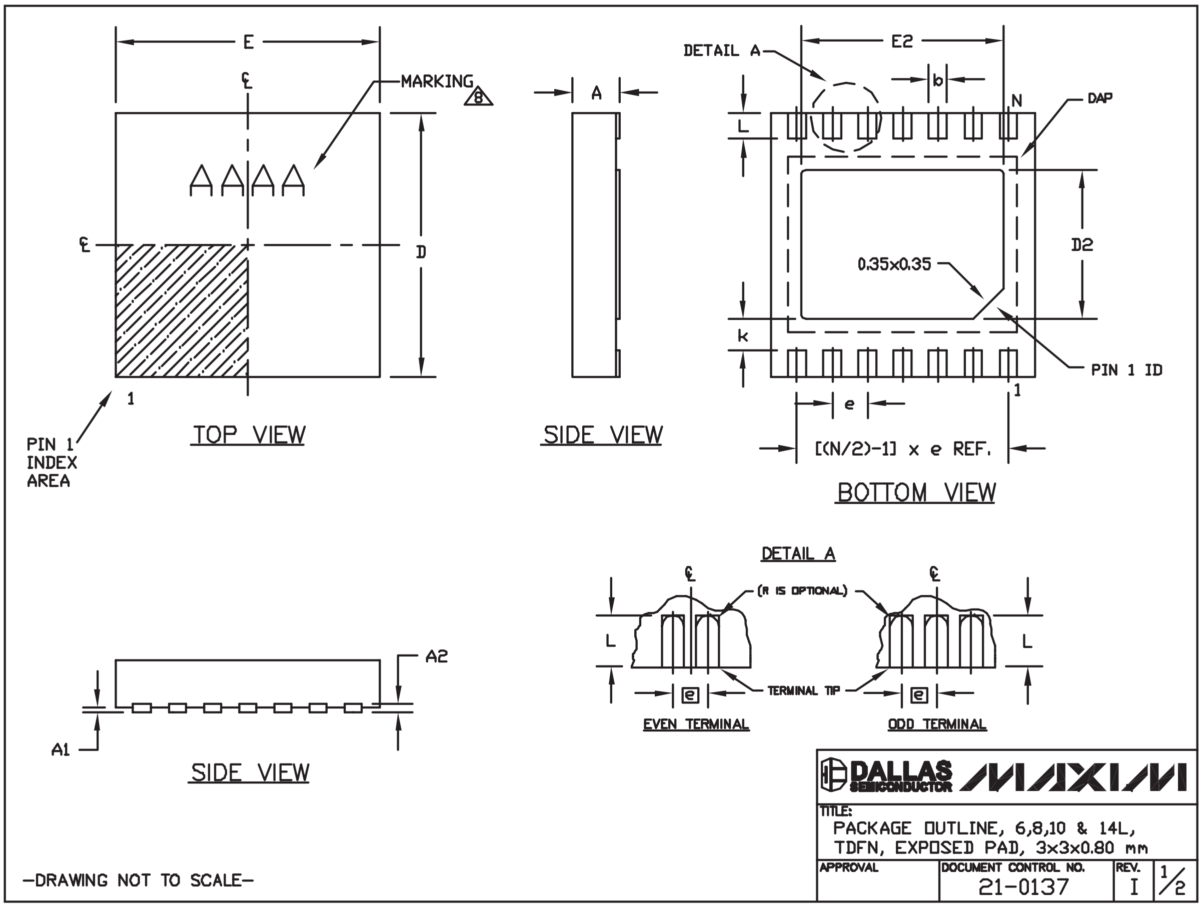
Figure 5. USB Charger Application

USB/AC Adapter, Li+ Linear Battery Charger with Integrated 50mΩ Battery Switch in TDFN

Package Information

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

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.
14 TDFN	T2444-4	**21-0137**



6, 8, &10L, DFN THIN.EPS

Package Information (continued)

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

COMMON DIMENSIONS		
SYMBOL	MIN.	MAX.
A	0.70	0.80
D	2.90	3.10
E	2.90	3.10
A1	0.00	0.05
L	0.20	0.40
k	0.25 MIN.	
A2	0.20 REF.	

PACKAGE VARIATIONS							
PKG. CODE	N	D2	E2	e	JEDEC SPEC	b	[(N/2)-1] x e
T633-2	6	1.50±0.10	2.30±0.10	0.95 BSC	MO229 / WEEA	0.40±0.05	1.90 REF
T833-2	8	1.50±0.10	2.30±0.10	0.65 BSC	MO229 / WEEC	0.30±0.05	1.95 REF
T833-3	8	1.50±0.10	2.30±0.10	0.65 BSC	MO229 / WEEC	0.30±0.05	1.95 REF
T1033-1	10	1.50±0.10	2.30±0.10	0.50 BSC	MO229 / WEED-3	0.25±0.05	2.00 REF
T1033-2	10	1.50±0.10	2.30±0.10	0.50 BSC	MO229 / WEED-3	0.25±0.05	2.00 REF
T1433-1	14	1.70±0.10	2.30±0.10	0.40 BSC	- - - -	0.20±0.05	2.40 REF
T1433-2	14	1.70±0.10	2.30±0.10	0.40 BSC	- - - -	0.20±0.05	2.40 REF

NOTES:
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY SHALL NOT EXCEED 0.08 mm.
3. WARPAGE SHALL NOT EXCEED 0.10 mm.
4. PACKAGE LENGTH/PACKAGE WIDTH ARE CONSIDERED AS SPECIAL CHARACTERISTIC(S).
5. DRAWING CONFORMS TO JEDEC MO229, EXCEPT DIMENSIONS "D2" AND "E2", AND T1433-1 & T1433-2.
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.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM

TITLE: PACKAGE OUTLINE, 6,8,10 & 14L, TDFN, EXPOSED PAD, 3x3x0.80 mm

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0137	I	2/2

USB/AC Adapter, Li+ Linear Battery Charger with Integrated 50mΩ Battery Switch in TDFN

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/05	Initial release	—
1	12/08	Updated Continuous Power Dissipation and derating factor in *Absolute Maximum Ratings*	2

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