ABSOLUTE MAXIMUM RATINGS

(Note 1)

Input Supply Voltage (V_{CC}) .... −0.3V to 10V
PROG, ITERM .... −0.3V to V_{CC} + 0.3V
BAT .... −0.3V to 7V
CHRG, ACPR, EN .... −0.3V to 10V
BAT Short-Circuit Duration .... Continuous
BAT Pin Current 1A
PROG Pin Current 1mA
Maximum Junction Temperature .... 125°C
Operating Temperature Range (Note 2) .. −40°C to 85°C
Storage Temperature Range .... −65°C to 125°C

PACKAGE/ORDER INFORMATION

TOP VIEW	ORDER PART NUMBER

TOP VIEW

ITERM `1` — `8` $\overline{EN}$
BAT `2` — `7` $\overline{ACPR}$
CHRG `3` — `6` V_{CC}
GND `4` — `5` PROG

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DD PACKAGE
8-LEAD (3mm × 3mm) PLASTIC DFN
T_{JMAX} = 125°C, θ_{JA} = 40°C/W (NOTE 3)
EXPOSED PAD IS GROUND (PIN 9)
MUST BE SOLDERED TO PCB

ORDER PART NUMBER

LTC4068EDD-4.2
LTC4068XEDD-4.2

DD PART MARKING

LBHZ
LBQB

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_{CC} = 5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
V_{CC}	Input Supply Voltage		●	4.25		6.5	V
I_{CC}	Input Supply Current	Charge Mode (Note 4), R_{PROG} = 10k	●		0.4	1	mA
		Standby Mode (Charge Terminated)	●		200	500	µA
		Shutdown Mode ($\overline{EN}$ = 5V, $V_{CC} < V_{BAT}$ or $V_{CC} < V_{UV}$)	●		25	50	µA
V_{FLOAT}	Regulated Output (Float) Voltage	0°C ≤ T_A ≤ 85°C, 4.3V < V_{CC} < 6.5V		4.158	4.2	4.242	V
I_{BAT}	BAT Pin Current	R_{PROG} = 10k, Current Mode	●	92	100	105	mA
		R_{PROG} = 2k, Current Mode	●	465	500	535	mA
		Standby Mode, V_{BAT} = 4.2V	●		−2.5	−6	µA
		Shutdown Mode ($\overline{EN}$ = 5V, $V_{CC} < V_{BAT}$ or $V_{CC} < V_{UV}$)			±1	±2	µA
		Sleep Mode, V_{CC} = 0V			±1	±2	µA
I_{TRIKL}	Trickle Charge Current	$V_{BAT} < V_{TRIKL}$, R_{PROG} = 2k (Note 5)	●	30	45	60	mA
V_{TRIKL}	Trickle Charge Threshold Voltage	R_{PROG} = 10k, V_{BAT} Rising (Note 5)		2.8	2.9	3	V
V_{TRHYS}	Trickle Charge Hysteresis Voltage	R_{PROG} = 10k (Note 5)			80		mV
V_{UV}	V_{CC} Undervoltage Lockout Voltage	From V_{CC} Low to High	●	3.7	3.8	3.92	V
V_{UVHYS}	V_{CC} Undervoltage Lockout Hysteresis		●	150	200	300	mV
$V_{\overline{EN}(IL)}$	$\overline{EN}$ Pin Input Low Voltage		●	0.4	0.7		V
$V_{\overline{EN}(IH)}$	$\overline{EN}$ Pin Input High Voltage		●		0.7	1	V
$R_{\overline{EN}}$	$\overline{EN}$ Pin Pull-Down Resistor		●	1.2	2	5	MΩ
V_{ASD}	$V_{CC} - V_{BAT}$ Lockout Threshold	V_{CC} from Low to High		70	100	140	mV
		V_{CC} from High to Low		5	30	50	mV
I_{TERM}	Charge Termination Current Threshold	R_{TERM} = 1k	●	90	100	110	mA
		R_{TERM} = 5k	●	17.5	20	22.5	mA
V_{PROG}	PROG Pin Voltage	R_{PROG} = 10k, Current Mode		0.93	1	1.07	V
$V_{\overline{CHRG}}$	$\overline{CHRG}$ Pin Output Low Voltage	$I_{\overline{CHRG}}$ = 5mA			0.35	0.6	V
$V_{\overline{ACPR}}$	$\overline{ACPR}$ Pin Output Low Voltage	$I_{\overline{ACPR}}$ = 5mA			0.35	0.6	V
ΔV_{RECHRG}	Recharge Battery Threshold Voltage	$V_{FLOAT} - V_{RECHRG}$, 0°C ≤ T_A ≤ 85°C		60	100	140	mV

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LINEAR TECHNOLOGY

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_{CC} = 5V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
T_{LIM}	Junction Temperature in Constant Temperature Mode				120		°C
R_{ON}	Power FET "ON" Resistance (Between V_{CC} and BAT)				600		mΩ
t_{SS}	Soft-Start Time	I_{BAT} = 0 to I_{BAT} =1000V/R_{PROG}			100		μs
$t_{RECHARGE}$	Recharge Comparator Filter Time	V_{BAT} High to Low		0.75	2	4.5	ms
t_{TERM}	Termination Comparator Filter Time	I_{BAT} Drops Below Charge Termination Threshold		400	1000	2500	μs

Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

Note 2: The LTC4068E-4.2/LTC4068XE-4.2 are guaranteed to meet performance specifications from 0°C to 70°C. Specifications over the −40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Note 3: Failure to solder the exposed backside of the package to the PC board will result in a thermal resistance much higher than 40°C/W.

Note 4: Supply current includes PROG pin current and ITERM pin current (approximately 100μA each) but does not include any current delivered to the battery through the BAT pin (approximately 100mA).

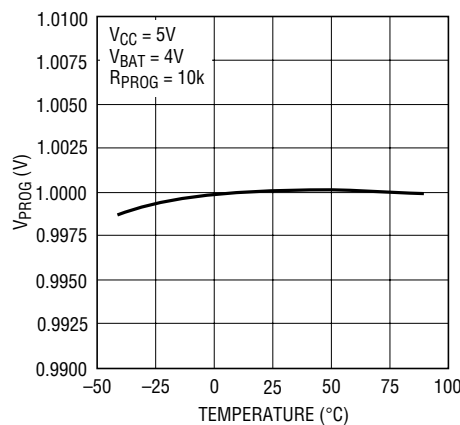**Note 5:** This parameter is not applicable to the LTC4068X.

TYPICAL PERFORMANCE CHARACTERISTICS

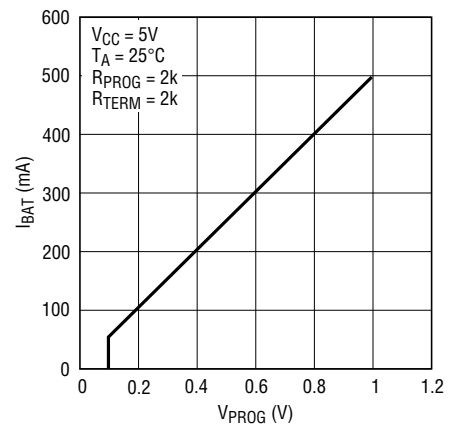**PROG Pin Voltage vs Supply Voltage (Constant Current Mode)**

V_{CC} = 5V
V_{BAT} = 4V
T_A = 25°C
R_{PROG} = 10k
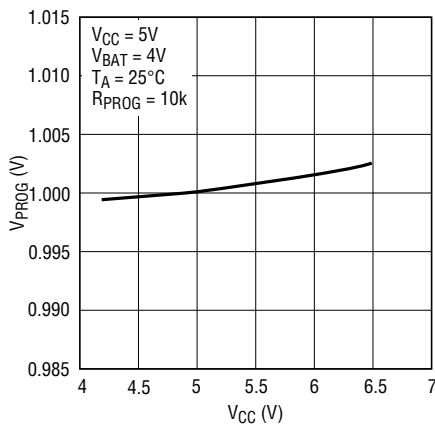
405842 G01

PROG Pin Voltage vs Temperature

V_{CC} = 5V
V_{BAT} = 4V
R_{PROG} = 10k

405842 G02

Charge Current vs PROG Pin Voltage

V_{CC} = 5V
T_A = 25°C
R_{PROG} = 2k
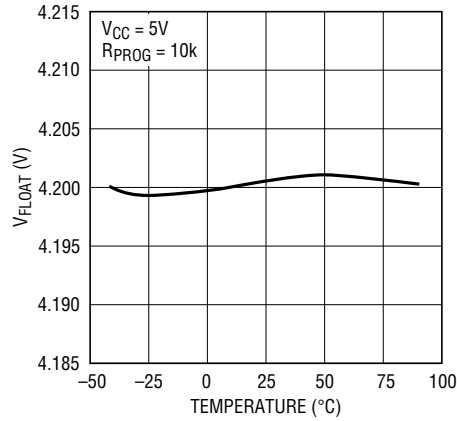R_{TERM} = 2k

405842 G03

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TYPICAL PERFORMANCE CHARACTERISTICS

Regulated Output (Float) Voltage vs Charge Current
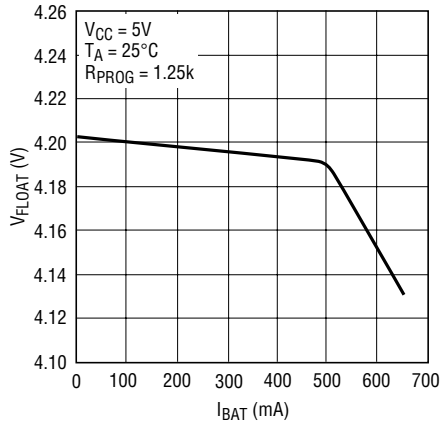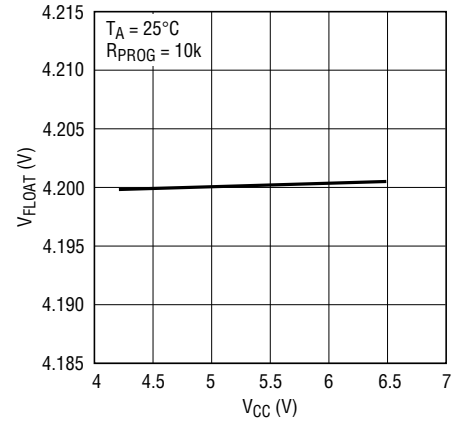

405842 G04
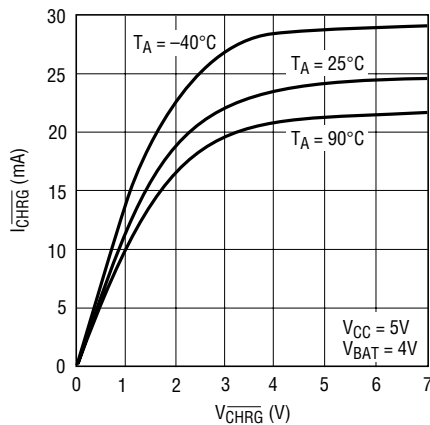
Regulated Output (Float) Voltage vs Temperature

405842 G05
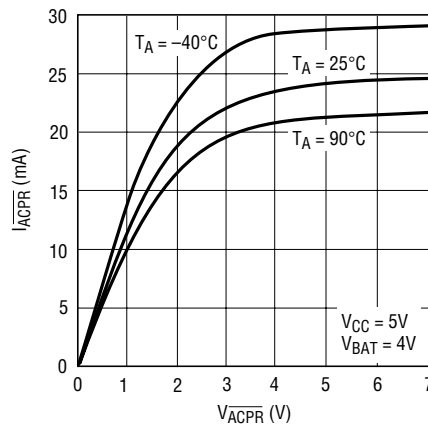
Regulated Output (Float) Voltage vs Supply Voltage

405842 G06

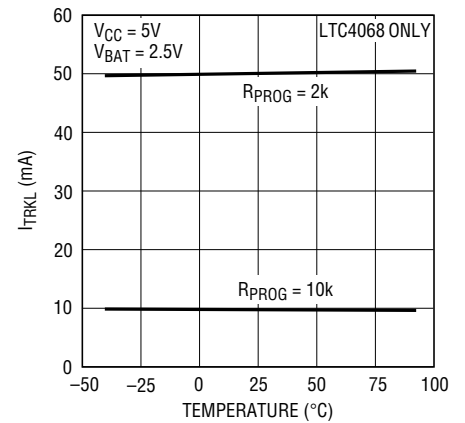**$\overline{CHRG}$ Pin I-V Curve (Pull-Down State)**

405842 G07

$\overline{ACPR}$ Pin I-V Curve (Pull-Down State)
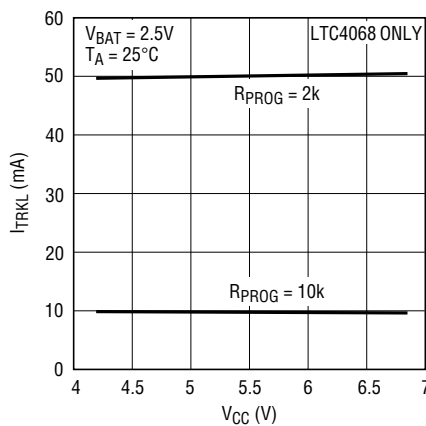

405842 G08
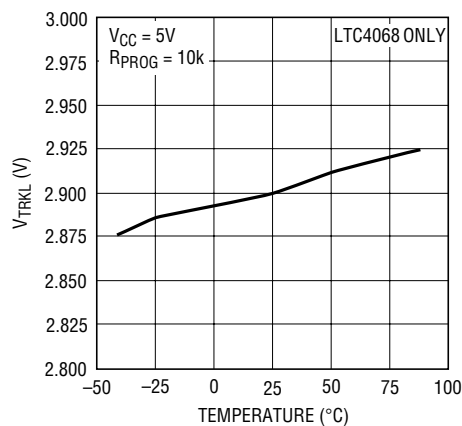
Trickle Charge Current vs Temperature

405842 G09

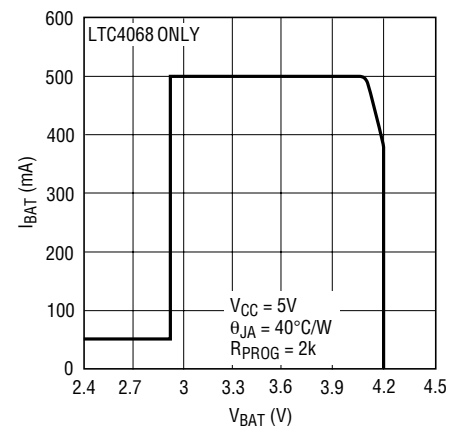**Trickle Charge Current vs Supply Voltage**

405842 G10

Trickle Charge Threshold Voltage vs Temperature
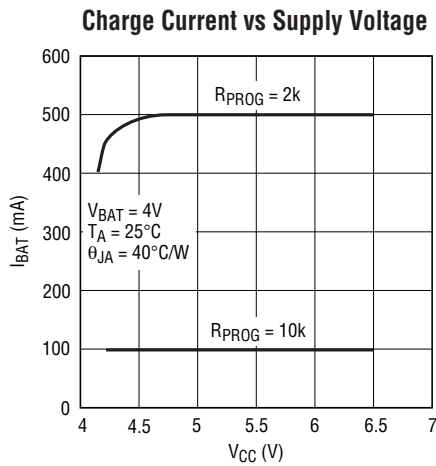

405842 G11
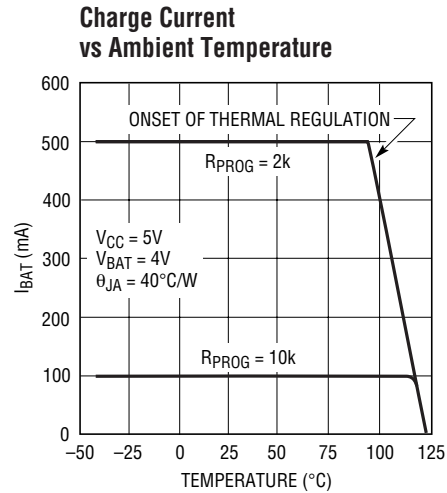
Charge Current vs Battery Voltage

405842 G12

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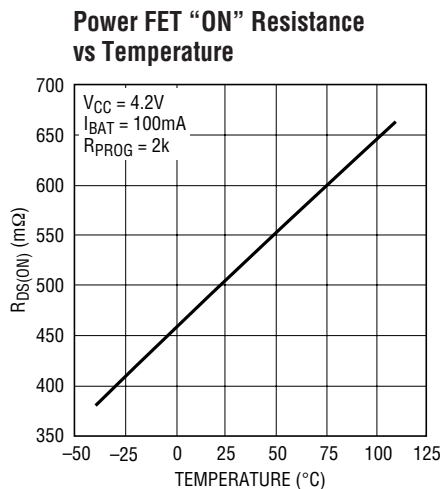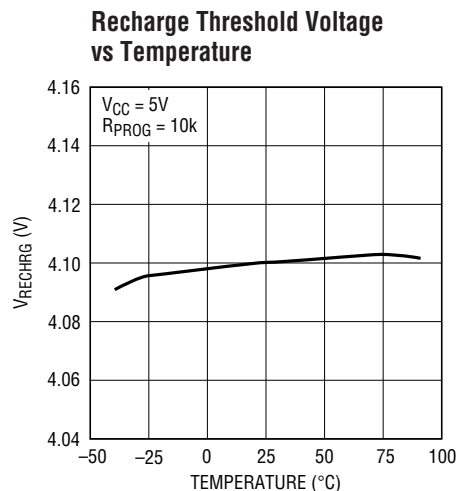# TYPICAL PERFORMANCE CHARACTERISTICS

Charge Current vs Supply Voltage

405842 G13

Charge Current vs Ambient Temperature

405842 G14

Power FET "ON" Resistance vs Temperature

405842 G17

Recharge Threshold Voltage vs Temperature

405842 G15

PIN FUNCTIONS

ITERM (Pin 1): Charge Termination Program. The charge termination current threshold current is programmed by connecting a 1% resistor, R_{TERM}, to ground. The current threshold I_{TERM}, is set by the following formula:

$$I_{TERM} = \frac{100V}{R_{TERM}}, R_{TERM} = \frac{100V}{I_{TERM}}$$

BAT (Pin 2): Charge Current Output. Provides charge current to the battery from the internal P-channel MOSFET, and regulates the final float voltage to 4.2V. An internal precision resistor divider from this pin sets the float voltage. This divider is disconnected in shutdown mode to minimize current drain from the battery.

CHRG (Pin 3): Charge Status Open-Drain Output. When the battery is charging, the CHRG pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed, CHRG becomes high impedance.

GND (Pins 4, 9): Ground/Exposed Pad. The exposed backside package pad (Pin 9) is electrical ground and must be soldered to the PC board for maximum heat transfer.

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PIN FUNCTIONS

PROG (Pin 5): Charge Current Program and Charge Current Monitor. Charge current is programmed by connecting a 1% resistor, R_{PROG}, to ground. When charging in constant-current mode, this pin servos to 1V. In all modes, the voltage on this pin can be used to measure the charge current using the following formula:

$$I_{BAT} = (V_{PROG}/R_{PROG}) \bullet 1000$$

This pin is clamped to approximately 2.4V. Driving this pin to voltages beyond the clamp voltage can draw large currents and should be avoided.

V_{CC} (Pin 6): Positive Input Supply Voltage. Provides power to the charger. V_{CC} can range from 4.25V to 6.5V. This pin should be bypassed with at least a 1μF capacitor.

When V_{CC} is within 100mV of the BAT pin voltage, the LTC4068 enters shutdown mode dropping the battery drain current to less than 2μA.

$\overline{ACPR}$ (Pin 7): Power Supply Status Open-Drain Output. When V_{CC} is greater than the undervoltage lockout threshold and at least 100mV above V_{BAT}, the $\overline{ACPR}$ pin is pulled to ground; otherwise, the pin is high impedance.

$\overline{EN}$ (Pin 8): Enable Input . A logic high on the $\overline{EN}$ pin will put the LTC4068 into shutdown mode where the battery drain current is reduced to less than 2μA and the supply current is reduced to less than 50μA. A logic low or floating the $\overline{EN}$ pin (allowing an internal 2MΩ pull-down resistor to pull this pin low) enables charging.

BLOCK DIAGRAM

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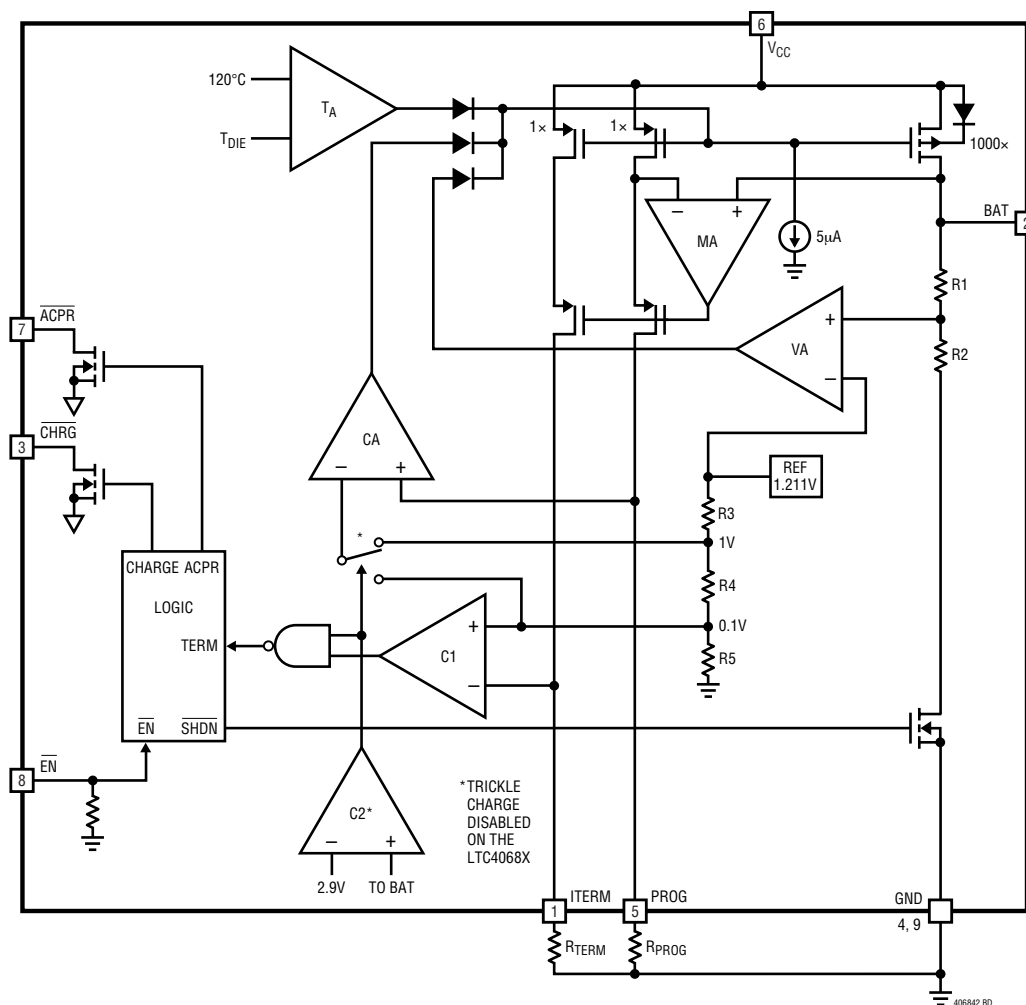
OPERATION

The LTC4068 is a single cell lithium-ion battery charger using a constant-current/constant-voltage algorithm. It can deliver up to 950mA of charge current (using a good thermal PCB layout) with a final float voltage accuracy of ±1%. The LTC4068 includes an internal P-channel power MOSFET and thermal regulation circuitry. No blocking diode or external current sense resistor is required; thus, the basic charger circuit requires only two external components. Furthermore, the LTC4068 is capable of operating from a USB power source.

Normal Charge Cycle

A charge cycle begins when the voltage at the V_{CC} pin rises above the UVLO threshold level and a 1% program resistor is connected from the PROG pin to ground. If the BAT pin is less than 2.9V, the charger enters trickle charge mode. In this mode, the LTC4068 supplies approximately 1/10th the programmed charge current to bring the battery voltage up to a safe level for full current charging. (Note: The LTC4068X does not include this trickle charge feature.)

When the BAT pin voltage rises above 2.9V, the charger enters constant-current mode where the programmed charge current is supplied to the battery. When the BAT pin approaches the final float voltage (4.2V), the LTC4068 enters constant-voltage mode and the charge current begins to decrease. When the charge current drops to the programmed termination threshold (set by the external resistor R_{TERM}), the charge cycle ends.

Programming Charge Current

The charge current is programmed using a single resistor from the PROG pin to ground. The charge current out of the BAT pin is 1000 times the current out of the PROG pin. The program resistor and the charge current are calculated using the following equations:

$$R_{PROG} = \frac{1000V}{I_{CHG}}, \quad I_{CHG} = \frac{1000V}{R_{PROG}}$$

Charge current out of the BAT pin can be determined at any time by monitoring the PROG pin voltage and using the following equation:

$$I_{BAT} = \frac{V_{PROG}}{R_{PROG}} \cdot 1000$$

Programming Charge Termination

The charge cycle terminates when the charge current falls below the programmed termination threshold. This threshold is set by connecting an external resistor, R_{TERM}, from the ITERM pin to ground. The charge termination current threshold (I_{TERM}) is set by the following equation:

$$I_{TERM} = \frac{100V}{R_{TERM}} = \frac{I_{CHG}}{10} \cdot \frac{R_{PROG}}{R_{TERM}}, R_{TERM} = \frac{100V}{I_{TERM}}$$

The termination condition is detected by using an internal filtered comparator to monitor the ITERM pin. When the ITERM pin voltage drops below 100mV[*] for longer than t_{TERM} (typically 1ms), charging is terminated. The charge current is latched off and the LTC4068 enters standby mode where the input supply current drops to 200μA. (Note: Termination is disabled in trickle charging and thermal limiting modes.)

I_{TERM} can be set to be 1/10th of I_{CHG} by shorting the ITERM pin to the PROG pin, thus eliminating the need for external resistor R_{TERM}. When configured in this way, I_{TERM} is always set to I_{CHG}/10, and the programmed charge current is set by the equation:

$$I_{CHG} = \frac{500V}{R_{PROG}}, R_{PROG} = \frac{500V}{I_{CHG}}^{**}$$

When charging, transient loads on the BAT pin can cause the ITERM pin to fall below 100mV for short periods of time before the DC charge current has dropped to 10% of the programmed value. The 1ms filter time (t_{TERM}) on the termination comparator ensures that transient loads of this nature do not result in premature charge cycle termination. Once the *average* charge current drops below the programmed termination threshold, the LTC4068 terminates the charge cycle and ceases to provide any current out of the BAT pin. In this state, any load on the BAT pin must be supplied by the battery.

The LTC4068 constantly monitors the BAT pin voltage in standby mode. If this voltage drops below the 4.1V recharge

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[*]Any external sources that hold the ITERM pin above 100mV will prevent the LTC4068 from terminating a charge cycle.
[**]These equations apply only when the ITERM pin is shorted to the PROG pin.

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OPERATION

threshold (V_{RECHRG}), another charge cycle begins and charge current is once again supplied to the battery. To manually restart a charge cycle when in standby mode, the input voltage must be removed and reapplied or the charger must be shut down and restarted using the EN pin. Figure 1 shows the state diagram of a typical charge cycle.
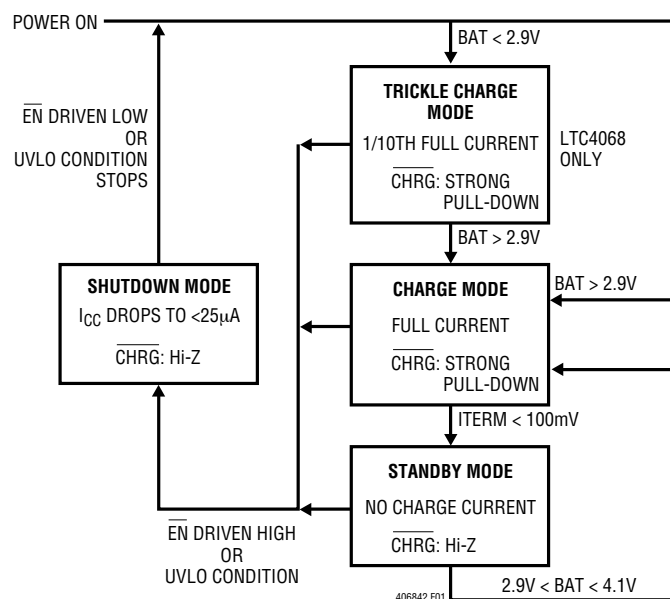

Figure 1. State Diagram of a Typical Charge Cycle

Charge Status Indicator (CHRG)

The charge status output has two states: pull-down and high impedance. The pull-down state indicates that the LTC4068 is in a charge cycle. Once the charge cycle has terminated or the LTC4068 is disabled, the pin state becomes high impedance.

Power Supply Status Indicator (ACPR)

The power supply status output has two states: pull-down and high impedance. The pull-down state indicates that V_{CC} is above the UVLO threshold (3.8V) and is also 100mV above the battery voltage. If these conditions are not met, the ACPR pin is high impedance indicating that the LTC4068 is unable to charge the battery.

Thermal Limiting

An internal thermal feedback loop reduces the programmed charge current if the die temperature attempts to rise above a preset value of approximately 120°C. This feature protects the LTC4068 from excessive temperature and allows the user to push the limits of the power handling capability of a given circuit board without risk of damaging the LTC4068. The charge current can be set according to typical (not worst case) ambient temperature with the assurance that the charger will automatically reduce the current in worst-case conditions. DFN power considerations are discussed further in the Applications Information section.

Undervoltage Lockout (UVLO)

An internal undervoltage lockout circuit monitors the input voltage and keeps the charger in shutdown mode until V_{CC} rises above the undervoltage lockout threshold. The UVLO circuit has a built-in hysteresis of 200mV. Furthermore, to protect against reverse current in the power MOSFET, the UVLO circuit keeps the charger in shutdown mode if V_{CC} falls to within 30mV of the BAT voltage. If the UVLO comparator is tripped, the charger will not come out of shutdown mode until V_{CC} rises 100mV above the BAT voltage.

Manual Shutdown

At any point in the charge cycle, the LTC4068 can be put into shutdown mode by driving the EN pin high. This reduces the battery drain current to less than 2µA and the supply current to less than 50µA. When in shutdown mode, the CHRG pin is in the high impedance state. A new charge cycle can be initiated by driving the EN pin low. An internal resistor pull-down on this pin forces the LTC4068 to be enabled if the pin is allowed to float.

Automatic Recharge

Once the charge cycle is terminated, the LTC4068 continuously monitors the voltage on the BAT pin using a comparator with a 2ms filter time ($t_{RECHARGE}$). A charge cycle restarts when the battery voltage falls below 4.10V (which corresponds to approximately 80% to 90% battery capacity). This ensures that the battery is kept at, or near, a fully

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APPLICATIONS INFORMATION

charged condition and eliminates the need for periodic charge cycle initiations. The $\overline{CHRG}$ output enters a pull-down state during recharge cycles.

If the battery is removed from the charger, a sawtooth waveform of approximately 100mV appears at the charger output. This is caused by the repeated cycling between termination and recharge events. This cycling results in pulsing at the $\overline{CHRG}$ output; an LED connected to this pin will exhibit a blinking pattern, indicating to the user that a battery is not present. The frequency of the sawtooth is dependent on the amount of output capacitance.

Stability Considerations

The constant-voltage mode feedback loop is stable without an output capacitor, provided a battery is connected to the charger output. With no battery present, an output capacitor on the BAT pin is recommended to reduce ripple voltage. When using high value, low ESR ceramic capacitors, it is recommended to add a 1Ω resistor in series with the capacitor. No series resistor is needed if tantalum capacitors are used.

In constant-current mode, the PROG pin is in the feedback loop, not the battery. The constant-current mode stability is affected by the impedance at the PROG pin. With no additional capacitance on the PROG pin, the charger is stable with program resistor values as high as 20k; however, additional capacitance on this node reduces the maximum allowed program resistor. The pole frequency at the PROG pin should be kept above 100kHz. Therefore, if the PROG pin is loaded with a capacitance, C_{PROG}, the following equation can be used to calculate the maximum resistance value for R_{PROG}:

$$R_{PROG} \le \frac{1}{2\pi \cdot 10^5 \cdot C_{PROG}}$$

Average, rather than instantaneous charge current may be of interest to the user. For example, if a switching power supply operating in low current mode is connected in parallel with the battery, the average current being pulled out of the BAT pin is typically of more interest than the instantaneous current pulses. In such a case, a simple RC

filter can be used on the PROG pin to measure the average battery current, as shown in Figure 2. A 10k resistor has been added between the PROG pin and the filter capacitor to ensure stability.
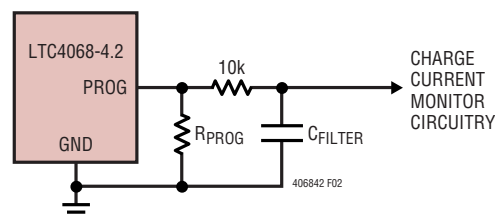

Figure 2. Isolating Capacitive Load on PROG Pin and Filtering

Power Dissipation

It is not necessary to design for worst-case power dissipation scenarios because the LTC4068 automatically reduces the charge current during high power conditions. The conditions that cause the LTC4068 to reduce charge current through thermal feedback can be approximated by considering the power dissipated in the IC. Nearly all of this power dissipation is generated by the internal MOSFET—this is calculated to be approximately:

$$P_D = (V_{CC} - V_{BAT}) \bullet I_{BAT}$$

where P_D is the power dissipated, V_{CC} is the input supply voltage, V_{BAT} is the battery voltage and I_{BAT} is the charge current. The approximate ambient temperature at which the thermal feedback begins to protect the IC is:

$$T_A = 120°C - P_D\theta_{JA}$$
$$T_A = 120°C - (V_{CC} - V_{BAT}) \bullet I_{BAT} \bullet \theta_{JA}$$

Example: An LTC4068 operating from a 5V supply is programmed to supply 800mA full-scale current to a discharged Li-Ion battery with a voltage of 3.3V. Assuming θ_{JA} is 50°C/W (see Thermal Considerations), the ambient temperature at which the LTC4068 will begin to reduce the charge current is approximately:

$$T_A = 120°C - (5V - 3.3V) \bullet (800mA) \bullet 50°C/W$$
$$T_A = 120°C - 1.36W \bullet 50°C/W = 120°C - 68°C$$
$$T_A = 52°C$$

APPLICATIONS INFORMATION

The LTC4068 can be used above 52°C ambient but the charge current will be reduced from the programmed 800mA. The approximate current at a given ambient temperature can be approximated by:

$$I_{BAT} = \frac{120°C - T_A}{\left(V_{CC} - V_{BAT}\right) \bullet \theta_{JA}}$$

Using the previous example with an ambient temperature of 60°C, the charge current will be reduced to approximately:

$$I_{BAT} = \frac{120°C - 60°C}{\left(5V - 3.3V\right) \bullet 50°C/W} = \frac{60°C}{85°C/A}$$

$$I_{BAT} = 706mA$$

Moreover, when thermal feedback reduces the charge current the voltage at the PROG pin is also reduced proportionally as discussed in the Operation section. It is important to remember that LTC4068 applications do not need to be designed for worst-case thermal conditions since the IC will automatically reduce power dissipation when the junction temperature reaches approximately 120°C.

Thermal Considerations

In order to deliver maximum charge current under all conditions, it is critical that the exposed metal pad on the backside of the LTC4068 package is soldered to the PC board ground. Correctly soldered to a 2500mm² double-sided 1oz copper board, the LTC4068 has a thermal resistance of approximately 40°C/W. Failure to make thermal contact between the exposed pad on the backside of the package and the copper board will result in thermal resistances far greater than 40°C/W. As an example, a correctly soldered LTC4068 can deliver over 800mA to a battery from a 5V supply at room temperature. Without a good backside thermal connection, this number will drop considerably.

V_CC Bypass Capacitor

Many types of capacitors can be used for input bypassing; however, caution must be exercised when using multilayer ceramic capacitors. Because of the self-resonant and high Q characteristics of some types of ceramic capacitors, high voltage transients can be generated under some start-up conditions such as connecting the charger input to a live power source. Adding a 1.5Ω resistor in series with an X5R ceramic capacitor will minimize start-up voltage transients. For more information, see Application Note 88.

Charge Current Soft-Start

The LTC4068 includes a soft-start circuit to minimize the inrush current at the start of a charge cycle. When a charge cycle is initiated, the charge current ramps from zero to full-scale current over a period of approximately 100μs. This has the effect of minimizing the transient current load on the power supply during start-up.

USB and Wall Adapter Power

The LTC4068 allows charging from both a wall adapter and a USB port. Figure 3 shows how to combine wall adapter and USB power inputs. A P-channel MOSFET, MP1, is used to prevent back conducting into the USB port when a wall adapter is present and a Schottky diode, D1, is used to prevent USB power loss through the 1k pull-down resistor.

Typically a wall adapter can supply more current than the 500mA-limited USB port. Therefore, an N-channel MOSFET, MN1, and an extra 3.3k program resistor are used to increase the charge current to 800mA when the wall adapter is present. The charge termination threshold remains fixed at 80mA.
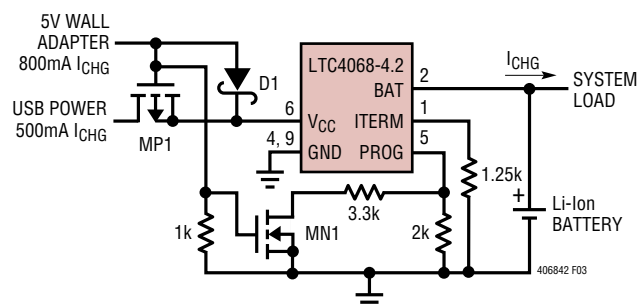

Figure 3. Combining Wall Adapter and USB Power

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APPLICATIONS INFORMATION

Reverse Polarity Input Voltage Protection

In some applications, protection from reverse polarity voltage on V_{CC} is desired. If the supply voltage is high enough, a series blocking diode can be used. In other cases, where the voltage drop must be kept low, a P-channel MOSFET can be used (as shown in Figure 4).

Figure 4. Low Loss Input Reverse Polarity Protection

PACKAGE DESCRIPTION

DD Package
8-Lead Plastic DFN (3mm × 3mm)
(Reference LTC DWG # 05-08-1698)

RECOMMENDED SOLDER PAD PITCH AND DIMENSIONS

BOTTOM VIEW—EXPOSED PAD

NOTE:
1. DRAWING TO BE MADE A JEDEC PACKAGE OUTLINE M0-229 VARIATION OF (WEED-1)
2. ALL DIMENSIONS ARE IN MILLIMETERS
3. DIMENSIONS OF EXPOSED PAD ON BOTTOM OF PACKAGE DO NOT INCLUDE
   MOLD FLASH. MOLD FLASH, IF PRESENT, SHALL NOT EXCEED 0.15mm ON ANY SIDE
4. EXPOSED PAD SHALL BE SOLDER PLATED
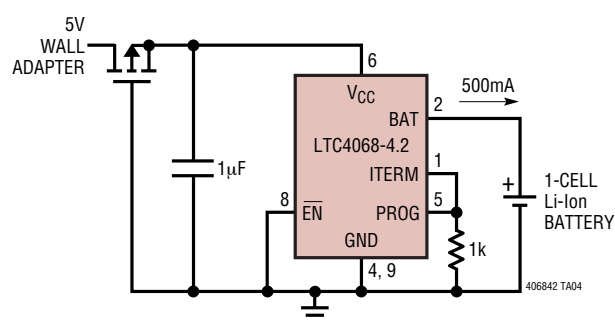
TYPICAL APPLICATIONS

Full Featured Single Cell Li-Ion Charger

405642 TA03
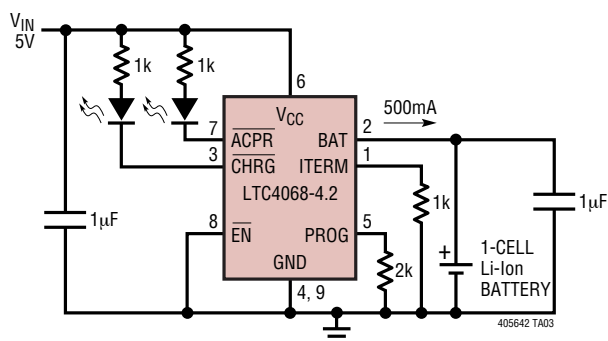
Li-Ion Battery Charger with Reverse Polarity Input Protection

406842 TA04

USB/Wall Adapter Power Li-Ion Charger

406842 TA05
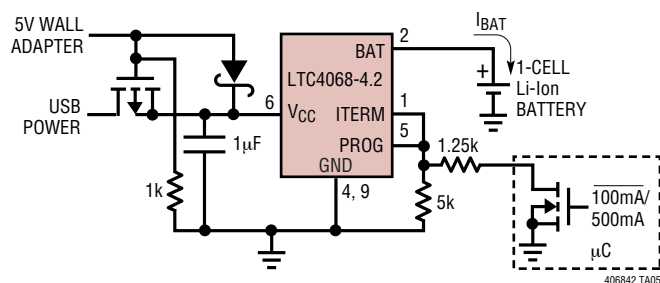
RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC1732	Lithium-Ion Linear Battery Charger Controller	Simple Charger uses External FET, Features Preset Voltages, C/10 Charger Detection and Programmable Timer, Input Power Good Indication
LTC1733	Monolithic Lithium-Ion Linear Battery Charger	Standalone Charger with Programmable Timer, Up to 1.5A Charge Current
LTC1734	Lithium-Ion Linear Battery Charger in ThinSOT™	Simple ThinSOT Charger, No Blocking Diode, No Sense Resistor Needed
LTC1734L	Lithium-Ion Linear Battery Charger in ThinSOT	Low Current Version of LTC1734; 50mA ≤ I_{CHRG} ≤ 180mA
LTC1998	Lithium-Ion Low Battery Detector	1% Accurate 2.5µA Quiescent Current, SOT-23
LTC4007	4A Multicell Li-Ion Battery Charger	Standalone Charger, 6V ≤ V_{IN} ≤ 28V, Up to 96% Efficiency, ±0.8% Charging Voltage Accuracy
LTC4050	Lithium-Ion Linear Battery Charger Controller	C/10 Charger Detection and Programmable Timer, Thermistor Interface
LTC4052	Monolithic Lithium-Ion Battery Pulse Charger	No Blocking Diode or External Power FET Required, ≤1.5A Charge Current
LTC4053	USB Compatible Monolithic Li-Ion Battery Charger	Standalone Charger with Programmable Timer, Up to 1.25A Charge Current
LTC4054	Standalone Linear Li-Ion Battery Charger in ThinSOT	Thermal Regulation Prevents Overheating, C/10 Termination, C/10 Indicator, Up to 800mA Charge Current
LTC4057	Li-Ion Linear Battery Charger	Up to 800mA Charge Current, Thermal Regulation, ThinSOT Package
LTC4058 LTC4058X	Standalone Li-Ion Linear Charger in DFN	Up to 950mA Charge Current, Kelvin Sense for High Accuracy, C/10 Charge Termination
LTC4410	USB Power Manager	For Simultaneous Operation of USB Peripheral and Battery Charging from USB Port, Keeps Current Drawn from USB Port Constant, Keeps Battery Fresh, Use with the LTC4053, LTC1733, or LTC4054
LTC4411 LTC4412	Low Loss PowerPath™ Controller in ThinSOT	Automatic Switching Between DC Sources, Load Sharing, Replaces ORing Diodes

ThinSOT and PowerPath are trademarks of Linear Technology Corporation.

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