Description

The EC49018 is designed to work with Solar panel, wall adaptor and other types of USB chargers to charge a single Lithium Battery. It has Maximum Power Point Tracking (MPPT) function built-in to charge a given battery with the maximum available power from the power source. EC49018can automatically switch among three different charging modes, trickle charge, constant-current charge, and constant-voltage charge. Its PSOP8 and SOT23-6 packages and low external component count make the EC49018ideally suited for portable applications. No blocking diode is required due to the internal anti-reverse-current architecture that will stop the IC and other components to consume the battery power when the charger is removed. Thermal feedback regulates the charge current to limit the die temperature during high power operation or high ambient temperature. The charge voltage is fixed at 4.2V, and the charge current can be programmed externally with a single resistor. The EC49018 automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached. EC49018 also features current monitor, under voltage lockout, automatic recharge and two status pins to indicate charge termination and the presence of an input voltage.

Features

◆Programmable Charge Current Up to 1000mA
◆Maximum power point tracking（MPPT）
◆No MOSFET, Sense Resistor or Blocking Diode Required
◆Complete Linear Charger in SOP-8, SOT23-6 Package for Single Cell Lithium-Ion Batteries
◆Constant-Current/Constant-Voltage
◆Charges Single Cell Li-Ion Batteries Directly from USB Port
◆Preset 4.2V Charge Voltage with ±1% Accuracy
◆Automatic Recharge
◆Two Charge Status Output Pins
◆C/10 Charge Termination
◆2.9V Trickle Charge Threshold
◆Soft-Start Limits Inrush Current
◆Available Radiator in PSOP8, SOT23-6 ，DFN2*2-6 Package, the Radiator need connect GND or impending
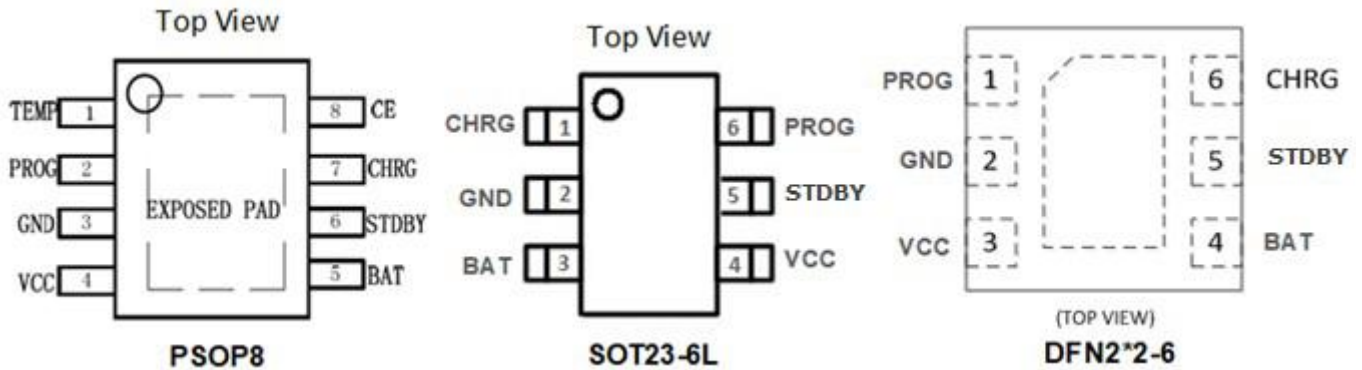
Applications

◆Charging Docks and Cradles
◆Cellular Telephones, PDAs, GPS
◆MP3、MP4 Player
◆Digital Still Cameras, Portable Devices
◆USB Bus-Powered Chargers, Chargers

Typical Application Circuit
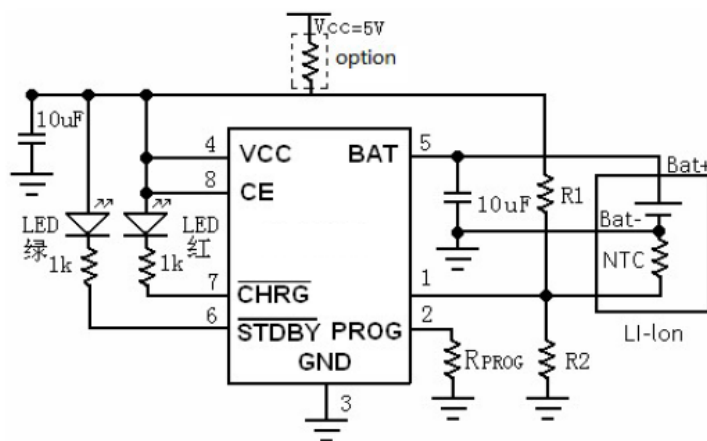
Pin Configuration

Pin Description

Pin	PSOP8 No	SOT23-6 No	DFN2*2-6 No	Pin Function Description
TEMP	1			Connecting TEMP pin to NTC thermistor's output in Lithium ion battery pack. When Temp is tied to GND, this function is disabled. The other functions are normal.
PROG	2	6	1	Constant charge current setting and charge current monitor pin
GND	3	2	2	Ground pin
VCC	4	4	3	Input Voltage pin
BAT	5	3	4	Connect the positive terminal of the battery to BAT pin
STDBY	6	5	5	Open Drain Charge Status Output
CHRG	7	1	6	Open Drain Charge Status Output
CE	8			Chip Enable Input

Ordering Information

EC49018NN XX_ X

R：Tape & Reel

Package Type：
MH=SOP 8 (EXPOSED PAD)

Absolute Maximum Rating

Parameter	Symbol	Value	Units
Input Supply Voltage	V^{in}	10note1	V
BAT Voltage	V^{BAT+}	7	V
TEMP/CE	V^{TEMP}	7	V
CHRG / STDBY	V^{CHRG}	7	V
BAT Pin Current	I^{BAT}	1500	mA
PROG Pin Current	I^{PROG}	1500	uA
Max Junction Temperature		150	°C
Thermal Resistance	Θ^{JA}	58	℃/W
Storage Temperature		-40～165	℃
Lead Temperature (Soldering, 10 sec)		260±5	℃

Note1：The electrical surge can be as high as 10V. The max working voltage can be 7V.

Operating Rating

Parameter	Value	Units
Junction Temperature	-20～85	℃
Input Voltage	4.5~6	V

Functional Block Diagram

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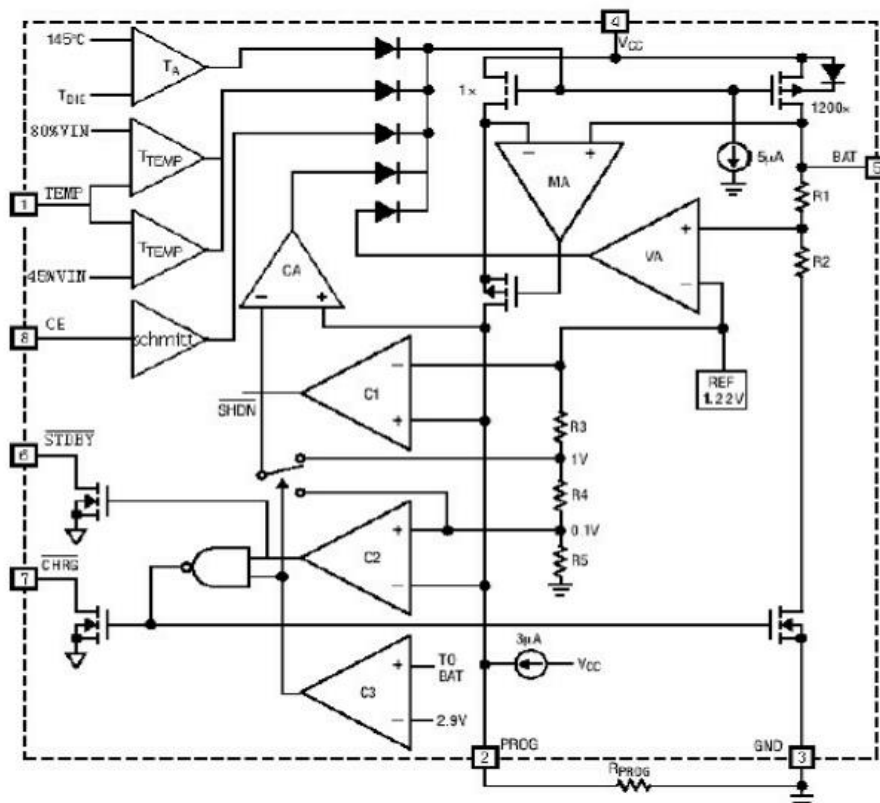
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Electrical Characteristics

V_{IN}=5V, T_A=25°C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	Input Supply Voltage		4.6	5	7	V
I_{CC}	Input Supply Current	Charge Mode，R_{PROG}=2K		146		μA
		Standby Mode (Charge Terminated)		70		μA
		Shutdown Mode (R_{PROG} Not Connected, V_{CC} < V_{BAT}, or V_{CC} < V_{UV})		30		μA
V_{FLOAT}	Regulated Output Voltage	I_{BAT} = 30mA, R_{PROG}=10K	4.158	4.2	4.242	V
I_{BAT}	BAT Pin Current （V_{BAT} =4V）	R_{PROG}=2K，Current Mode		560		mA
		R_{PROG}=1K，Current Mode		1120		mA
		Standby Mode V_{BAT}=4.3V		—		μA
		Shutdown Mode Ven=0		1±1		μA
		Sleep Mode，V_{CC}=0V		—1		μA
I_{TRIKL}	Trickle Charge Current	V_{BAT}<V_{TRIKL}，R_{PROG}=2K		60		mA
V_{TRIKL}	Trickle Charge Threshold Voltage	R_{PROG}=2K，V_{BAT} Rising		2.9		V
V_{TRHYS}	Trickle voltage hysteresis voltage	R_{PROG}=2K		100		mV
V_{UV}	V_{CC} Under voltage Lockout Threshold	From V_{CC} Low to High		3.7		V
V_{UVHYS}	V_{CC} Under voltage Lockout Hysteresis			150		mV
V_{ASD}	V_{CC} – V_{BAT} Lockout Threshold Voltage	PROG Pin Rising		150		mV
		PROG Pin Falling		100		mV
I_{TERM}	C/10 Termination Current Threshold	R_{PROG}=2K		60		mA
		R_{PROG}=1K		100		mA
V_{PROG}	PROG Pin Voltage	R_{PROG}=2K，Current Mode		1.0		V
I_{CHRG}	CHRG Pin Weak Pull-Down Current	I_{CHRG} = 5mA			0.4	V
V_{STDBY}	STDBY Pin Output Low Voltage	I_{STDBY} =5mA			0.4	V
V_{TEMP-H}	TEMP pin voltage of the high-end flip			80		%Vcc
V_{TEMP-L}	TEMP pin voltage of the low-end flip			45		%Vcc
ΔV_{RECHRG}	Recharge Battery Threshold Voltage	V_{FLOAT} – V_{RECHRG}		150		mV
T_{LIM}	Thermal Protection Temperature			145		℃
R_{ON}	MOSFET Rds(ON)			550		mΩ
tss	Soft-Start Time	I_{BAT}=0 to 1120V/R_{PROG}		20		μs
tRECHARGE	Recharge Comparator Filter Time	V_{BAT} High to Low		1		ms
tTERM	Termination Comparator Filter Time	I_{BAT} Falling Below I_{CHG}/10		1		ms
Vmppt	Maximum Power Point Tracking Voltage			4.4		V
Iprog	PROG Pin Pull-Up Current			0.5		μA

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Typical Performance Characteristics
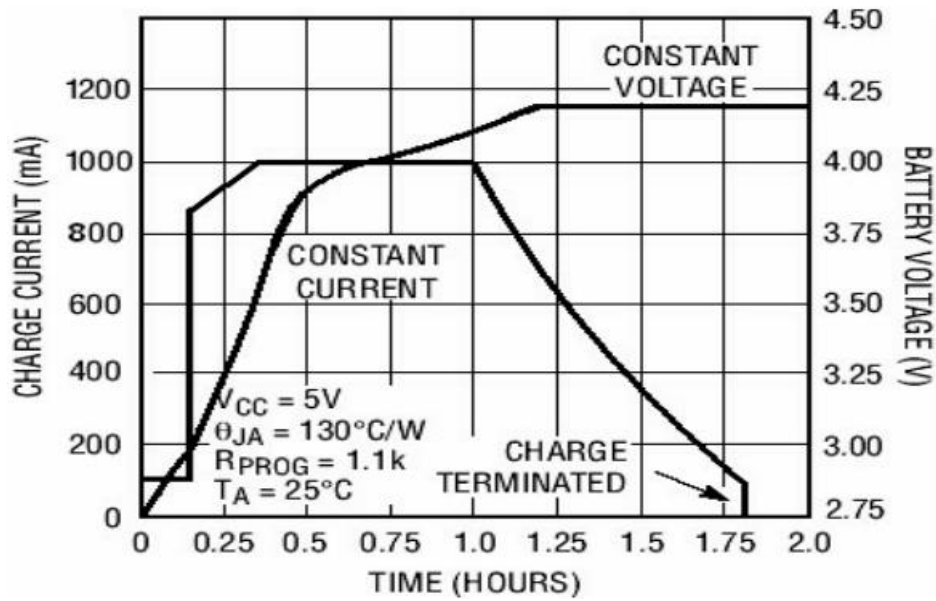
Complete Charge Cycle (1000mAh Battery)

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Applications Information

The EC49018 is a complete constant –current & constant-voltage linear charger for single cell lithium-ion batteries. It can deliver up to 1A of charging current. No blocking diode or external current sense resistor is required. EC49018 includes two Open-Drain charging status Pins: Charging and Full. It can also signal a bad battery with both pins going low, or both LED's are turned on. The internal thermal regulation circuit reduces the programmed charge current if the die temperature attempts to rise above a preset value of approximately 125℃. This feature prevents the EC49018 from going into the Over Temperature Protection (OTP), which will consequently extend the charging time, and allows the user to charge a given battery with the maximum speed. Another benefit of adopting thermal regulation is that the charging current can be set according to typical, not worst-case, ambient temperatures for a given application with the assurance that the charger will automatically reduce the current in worst-case conditions.

The charge cycle begins when the voltage at the VCC pin rises above the UVLO level, a current set resistor is connected from the PROG pin to ground, and the CE pin is pulled above the chip enable threshold. The CHRG pin outputs a logic low to indicate that the charge cycle is on going. At the beginning of the charge cycle, if the battery voltage is below 2.9V, the charge is in trickle charge mode to bring the cell voltage up to a safe level for fast charging. The charger goes into the fast charge constant-current mode once the voltage on the BAT pin rises above 2.9 V. In constant current mode, the charge current is set by RPROG. When the battery is charged close to the final voltage at around 4.15V, the charging current begins to decrease as the EC49018 enters the constant-voltage mode. When the current drops to charge termination threshold and voltage is reached the desired 4.2V, the charge cycle is terminated, and CHRG pin assumes a high impedance state to indicate that the charge cycle is terminated and STDBY pin is pulled low. The charge termination threshold is 10% of the user programmed value. To restart the charge cycle, remove the input voltage and reapply it, or momentarily force CE pin to 0V. The charge cycle can also be automatically restarted if the BAT pin voltage falls below the recharge threshold. The on-chip reference voltage, error amplifier and the resistor divider provide regulation voltage with 1% accuracy which is the requirement of lithium-ion and lithium polymer batteries. When the input voltage is not present, or input voltage is below VBAT, the charger goes into a sleep mode, dropping battery drain current to less than 1µA. This greatly reduces the current drain on the battery and increases the standby time. The charger can be shut down by forcing the CE pin to GND.

Programming charge current

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

$$R_{PROG} = \frac{1120}{I_{BAT}} \quad (\text{error} \pm 10\%)$$

In addition, the charge current can also be set from the following table:

R$_{PROG}$ (k)	I$_{BAT}$ (mA)
28	40
18.6	60
9.3	120
4.6	240
3.73	300
2.8	400
1.86	600
1.55	720
1.4	800
1.24	900
1.12	1000

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Charge termination

A charge cycle is terminated when the charge current falls to 1/10th the programmed value after the final float voltage is reached. This condition is detected by using an internal filtered comparator to monitor the PROG pin. When the PROG pin voltage falls below 100mV for longer than tTEMP (typically 1.8mS), Charging is terminated. The charge current is latched off and the EC49018 enters standby mode, where the input supply current drops to 55µA (Note: C/10 termination is disabled in trickle charging and thermal limiting modes).

During charging, transient loads on the BAT pin can cause the PROG pin to fall below 100mV for short periods of time before the DC charge current has dropped to 1/10th the programmed value. The 1.8mS filter time (tTEMP) 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 1/10th the programmed value, the EC49018 terminated the charge cycle and ceases to provide any current through the BAT pin. In this state all loads on the BAT pin must be supplied by the battery.

The EC49018 constantly monitors the BAT pin voltage in standby mode. If this voltage drops below the 4.02V recharge threshold (VRECHRG), another charge cycle begins and 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 PROG pin. Figure 1 shows the state diagram of a typical charge cycle.

Charge status indicator

 EC49018 has two open-drain status indicator output CHRG and STDBY. CHRG is pull-down when the EC49018 in a charge cycle. When the charging is completed, STDBY is pulled low. CHRG and STDBY are all in high impedance when the battery out of the normal temperature. To represent an abnormal state such as temperature is too high or too low, when TEMP pin in typical connection, both red LED and green LED will be turned off. The battery temperature sense function is disabled by connecting TEMP pin to GND. If battery is not connected to charger, CHRG pin outputs a PWM level to indicate no battery. If BAT pin connects a 10µF capacitor, the frequency of CHRG flicker about 1-4S. The following table is the summary:

| charger's status	Red led	Green led
Charging	light	dark
Battery in full state	dark	light
Under-voltage, battery's temperature is to high or too low, or not connect to battery (use TEMP)	dark	dark
BAT pin is connected to 10uF capacitor, No battery mode(TEMP=GND)	Green LED bright, Red LED flicker F=1-4 S	

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Outline Drawing For SOP8
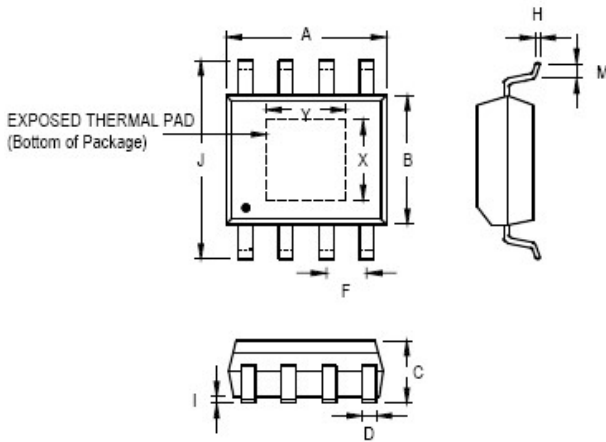
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.801	5.004	0.189	0.197
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.191	0.254	0.008	0.010
I	0.000	0.152	0.000	0.006
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050
X	2.057	2.515	0.081	0.099
Y	2.057	3.404	0.081	0.134

Outline Drawing For SOT23-6
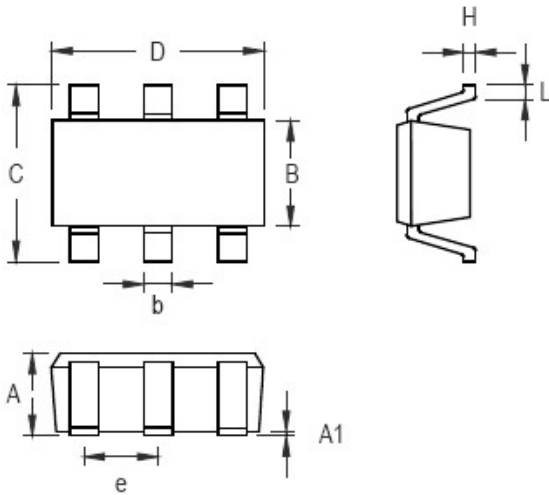
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.031	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.250	0.560	0.010	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

Outline Drawing For DFN2*2-6
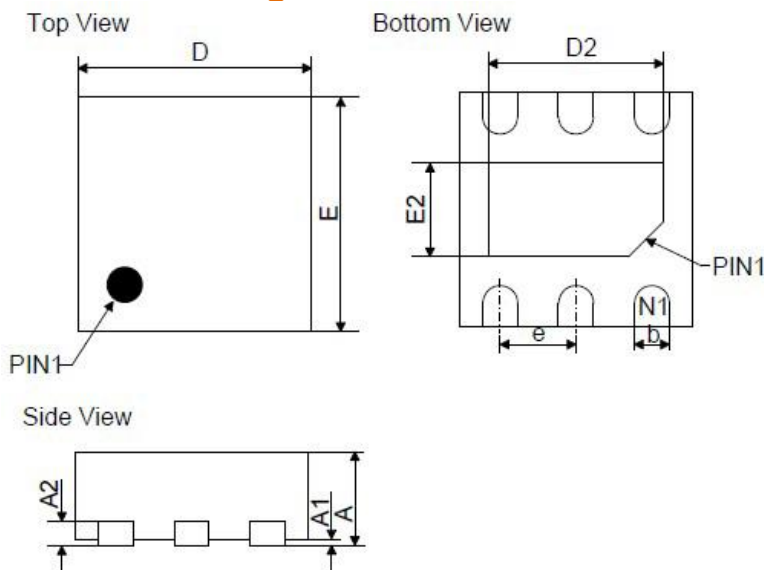
COMMON DIMENSIONS (MM)			
REF	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	-	0.05
A2	0.2 REF		
D	1.95	2.00	2.05
E	1.95	2.00	2.05
D2	1.35	1.50	1.60
E2	0.65	0.80	0.90
L	0.25	0.35	0.45
b	0.25	0.30	0.35
e	0.65 Bsc		

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