General Description

The EC49022 is a complete constant - current & constant-voltage linear charger for single cell lithium-ion batteries. Its SOP-8(Exposed PAD) package and low external component count make the EC49022 ideally suited for portable applications. In addition, the EC49022 can work within USB and wall adapter.

No blocking diode is required because of its internal PMOSFET architecture which is able to prevent the negative Charge Current. 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 4.3V, and the charge current can be programmed externally with a single resistor. The EC49022 automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached.

EC49022 Other features include battery temperature monitor, under voltage lockout, automatic recharge and two status pin to indicate charge termination and the presence of an input voltage.
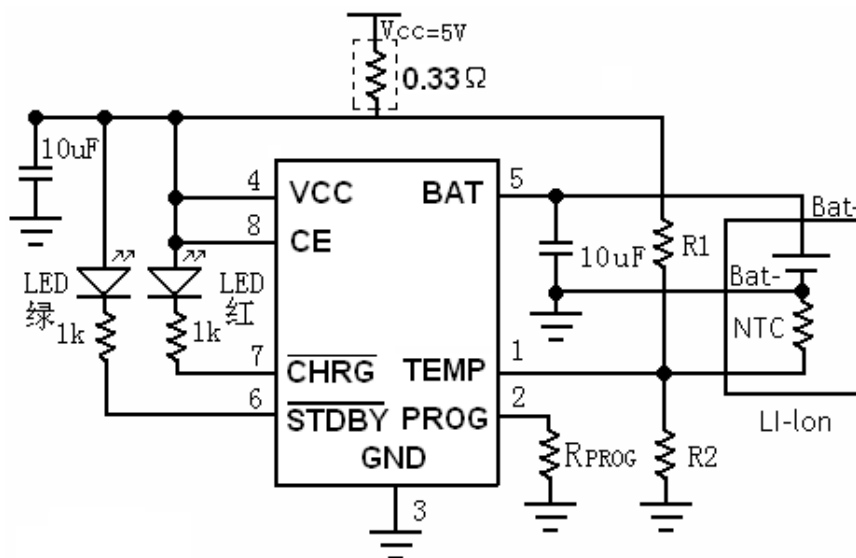
Features

- Programmable Charge Current Up to 1000mA
- No MOSFET, Sense Resistor or Blocking Diode Required
- Complete Linear Charger in SOP-8　Package for Single Cell Lithium-Ion Batteries
- Constant-Current/Constant-Voltage
- Preset 4.3V 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
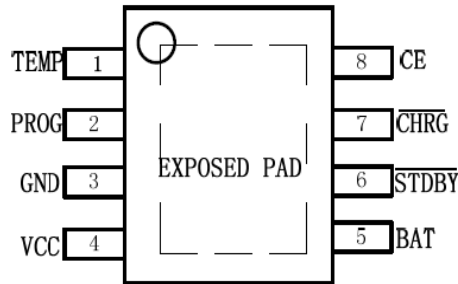- Battery Temperature monitor

Applications

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

Application Diagram

Pin Configuration

Pin Functions

Pin	Pin Function Description	Pin	Pin Function Description
TEMP	Connecting TEMP pin to NTC thermistor's output in Lithium ion battery pack. Terminate Charge when TEMP<45%Vcc or TEMP>80%Vcc. The function disable when TEMP connect to GND, but other function is work.	BAT	Connect the positive terminal of the battery to BAT pin
PROG	Constant charge current setting and charge current monitor pin	$\overline{STDBY}$	Charge completely Status Output, The status is Low Level when charge completely. Other status is high-impedance.
GND	Ground pin	$\overline{CHRG}$	Charging Status Output, The status is low level when charging, other status is high-impedance.
VCC	Input Voltage pin	CE	Chip Enable Input

Ordering Information

R：Tape & Reel

Package Type：
MH=SOP-8(Exposed PAD)
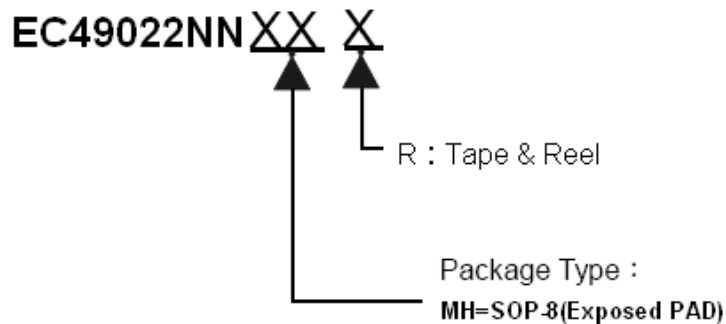
Package	Part Number	Marking	Marking Information
SOP-8 (Exposed PAD)	EC49022NNMHR	49022 LLLLL YYWWT	1. LLLLL：Lot No. 2. YYWW：date Code 3. T：Internal Tracking Code

1A, Single Cell Linear Lithium Battery Charger

Absolute Maximum Rating

Parameter	Symbol	Value	Units
Input Supply Voltage	V_{CC}	6.5	V
BAT Voltage	V_{BAT}	6.5	V
TEMP/CE	V_{TEMP}	6.5	V
$\overline{CHRG}$ / $\overline{STDBY}$	V_{CHRG}	6.5	V
BAT Pin Current	I_{BAT}	1200	mA
PROG Pin Current	I_{PROG}	1200	uA
Maximum Junction Temperature	T_J	150	°C

Operating Rating

Parameter	Symbol	Value	Units
Operating Temperature	T_A	-20 to +85	°C
Storage Temperature	T_{STG}	-40 to +125	℃
Lead Temperature (Soldering, 10sec)	T_{LED}	260	℃

Block Diagram
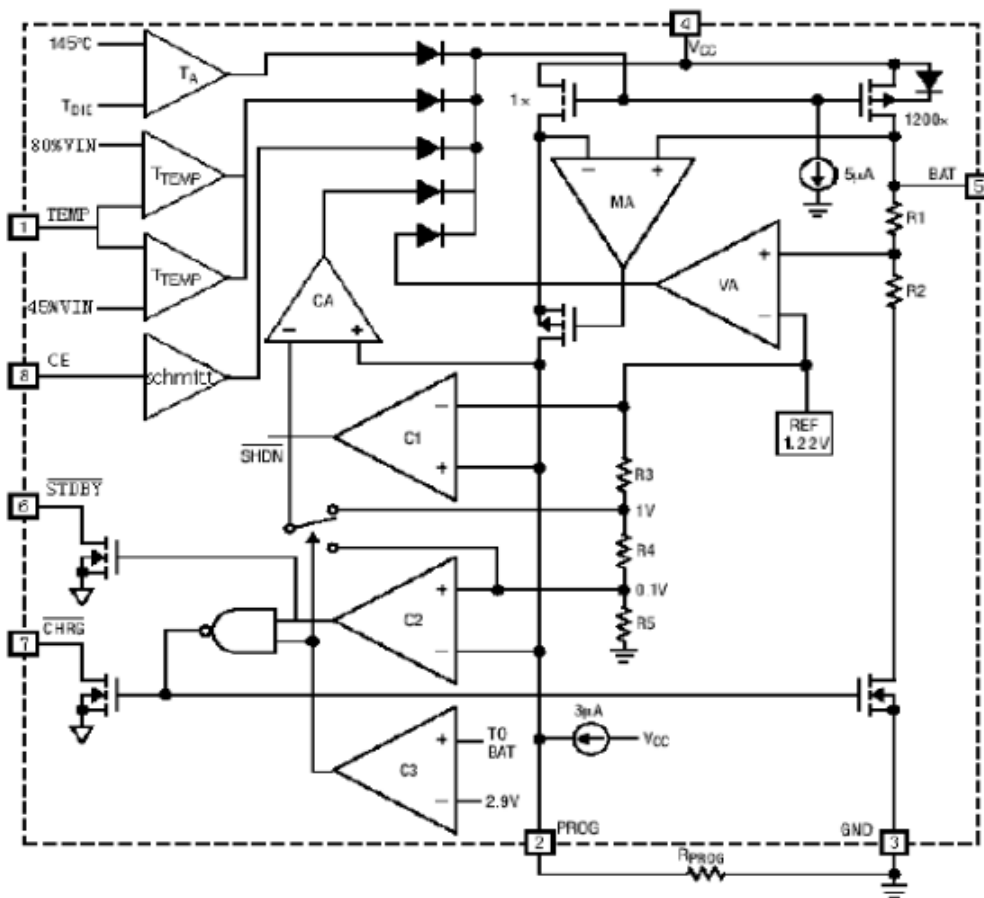
Electrical Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	Input Supply Voltage		4.0	5	6.5	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	4.3	4.34	4.38	V
I_{BAT}	BAT Pin Current (Current mode test condition V_{BAT}=4V)	R_{PROG} = 2K, Current Mode	—	560	—	mA
		R_{PROG} = 1K, Current Mode	—	1120	—	mA
		Standby Mode, VBAT = 4.3V	—	+/-1	—	µA
		Shutdown Mode (R_{PROG} Not Connected)	—	+/-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	2.8	2.9	3.0	V
V_{TRHYS}	Trickle Voltage hysteresis Voltage	R_{PROG}=2K	—	100	—	mV
V_{UV}	V_{CC} Undervoltage Lockout Threshold	From V_{CC} Low to High	—	3.7	—	V
V_{UVHYS}	V_{CC} Undervoltage Lockout Hysteresis		—	150	—	mV
V_{ASD}	V_{CC} – V_{BAT} Lockout Threshold Voltage	Vcc from Low to High	—	150	—	mV
		Vcc from High to Low	—	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	0.9	1.0	1.1	V
$V_{\overline{CHRG}}$	$\overline{CHRG}$ Pin Output Low Voltage	$I_{\overline{CHRG}}$ = 5mA	—	—	0.4	V
$V_{\overline{STDBY}}$	$\overline{STDBY}$ Pin Output Low Voltage	$I_{\overline{STDBY}}$ =5mA	—	—	0.4	V
V_{TEMP-H}	TEMP pin voltage of the high-end flip		—	80	—	%Vcc

Electrical Characteristics

V_{IN} = 5V; T_J = 25°C; unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{TEMP-L}	TEMP pin voltage of the low-end flip		—	45	—	%Vcc
$\triangle V_{RECHRG}$	Recharge Battery Threshold Voltage	V_{FLOAT} - V_{RECHRG}	—	150	—	mV
T_{LIM}	Thermal Protection Temperature		—	145	—	°C
t_{SS}	Soft-Start Time	I_{BAT} = 0 to 1120V/R_{PROG}	—	20	—	µs
$t_{RECHARGE}$	Recharge Comparator Filter Time	V_{BAT} High to Low	—	1	—	ms
t_{TERM}	Termination Comparator Filter Time	I_{BAT} Falling Below I_{CHG}/10	—	1	—	ms
I_{PROG}	PROG Pin Pull-Up Current		—	0.5	—	µA

Typical Performance Characteristics

V_{CC} = 5V
θ_{JA} = 130°C/W
R_{PROG} = 1.1k
T_A = 25°C
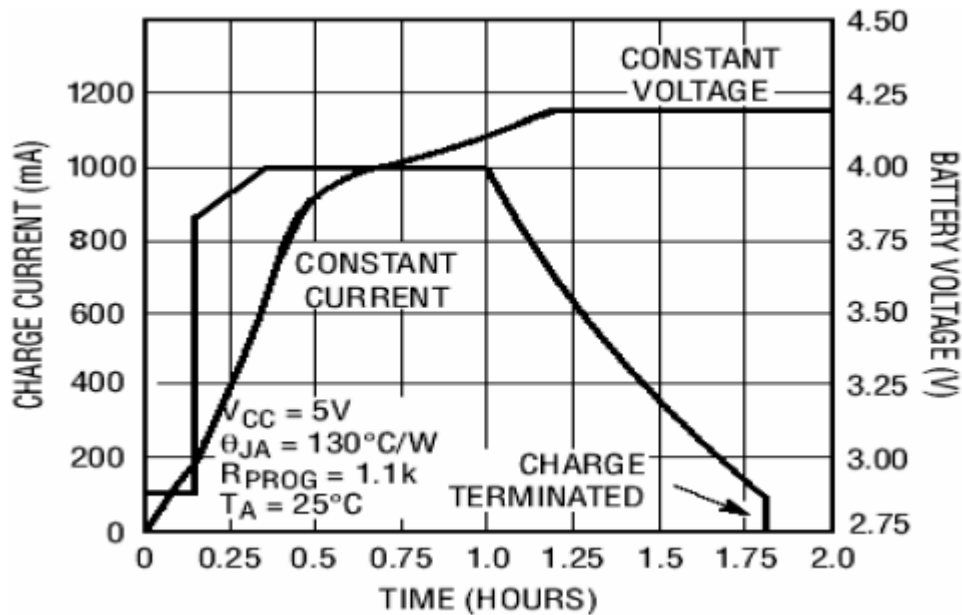
Complete Charge Cycle (1000mAh Battery)

Applications

The EC49022 is a complete constant –current & constant-voltage linear charger for single cell lithium-ion batteries. Constant-current & constant - voltage to charger batter by internal MOSFET .It can deliver up to 1A of charge current .No blocking diode or external current sense resistor is required. EC49022 include two

Open-Drain charge status Pins: Charge status indicator $\overline{CHRG}$ and battery failure status output $\overline{STDBY}$ .The internal thermal regulation circuit reduces the programmed charge current if the die temperature attempts to rise above a preset value of approximately 145℃. This feature protects the EC49022 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 EC49022 or the external components. Another benefit of adopting thermal regulation is that charge

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 V$_{CC}$ 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 $\overline{CHRG}$ 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 3V, the charge is in recharge mode to bring the cell voltage up to a safe level for charging. The charger goes into the fast charge constant-current mode once the voltage on the BAT pin rises above 3 V. In constant current mode, the charge current is set by R$_{PROG}$. When the battery approaches the regulation voltage 4.3V, the charge current begins to decrease as the EC49022 enters the constant-voltage mode. When the current drops to charge termination threshold, the charge cycle is terminated, and $\overline{CHRG}$ pin assumes a high impedance state to indicate that the charge cycle is terminated and $\overline{STDBY}$ pin is pulled low. The charge termination threshold is 10% of the current in constant current mode. 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 can meet the requirement of lithium-ion and lithium polymer batteries. When the input voltage is not present, or input voltage is below V$_{BAT}$, 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 shutdown 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 application, according the charge current to determine R$_{PROG}$,the relation between R$_{PROG}$ and charge current can reference the following chart：

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

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 t_{TEMP} (typically 1.8mS), Charging is terminated. The charge current is latched off and the EC49022 enters standby mode, where the input supply current drops to 70µA (Note:C/10 termination is disabled in trickle charging and thermal limiting modes).

When 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 (t_{TEMP}) 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 EC49022 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.

Charge status indicator

EC49022 has two open-drain status indicator output $\overline{CHRG}$ and $\overline{STDBY}$. $\overline{CHRG}$ is pull-down when the EC49022 in a charge cycle. In other status $\overline{CHRG}$ in high impedance. $\overline{CHRG}$ and $\overline{STDBY}$ are all in high impedance when the battery out of the normal temperature.

Represent in failure state, when TEMP pin in typical connecting, or the charger with no battery: red LED and green LED all don't light. The battery temperature sense function is disabled by connecting TEMP pin to GND. If battery is not connected to charger, $\overline{CHRG}$ pin outputs a PWM level to indicate no battery. If BAT pin connects a 10µF capacitor, the frequency of $\overline{CHRG}$ flicker about 1-4S, If not use status indicator should set status indicator output connected to GND.

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	

OUTLINE DRAWING SOP-8(Exposed PAD)
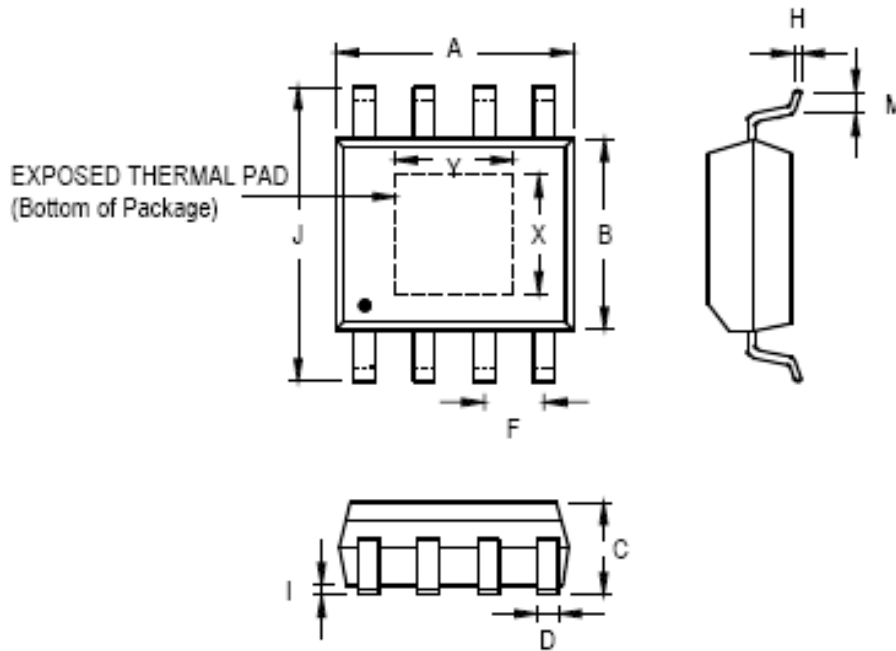
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.801	5.004	0.189	0.197
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.191	0.254	0.008	0.010
I	0.000	0.152	0.000	0.006
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050
X	2.057	2.515	0.081	0.099
Y	2.057	3.404	0.081	0.134