CL4054HB
500mA Li-ion Battery Linear Charger

Description

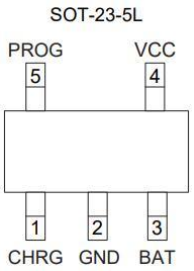
The CL4054HB is a standalone linear Li-ion battery charger with SOT23-5 package. With few external components, CL4054HB is well suited for a wide range of portable applications. Charging current can be programmed by an external resistor. The maximum withstand voltage of CL4054HB is 30V,In standby mode, supply current will be reduced to around 45uA. Other features include UVLO, automatic recharge, charge status indicators and thermal regulation.

Feature

- Up to 500mA Programmable Charge Current
- No External MOSFET, Sense Resistor, or Blocking Diode Required
- Standalone Linear Charger for Single Cell Li-ion Batteries
- Preset Charge Voltage with: 4.1V (TYP)
- Automatic Recharge
- C/10 Charge Termination
- 45uA Standby Supply Current
- 2.9V Trickle Charge Voltage
- Thermal Protection
- Soft-Start to Limit Inrush Current

Application

- Mobile Phone, PDA
- MP3, MP4
- Charger



Package Type : SOT23-5L

Typical Application Circuit

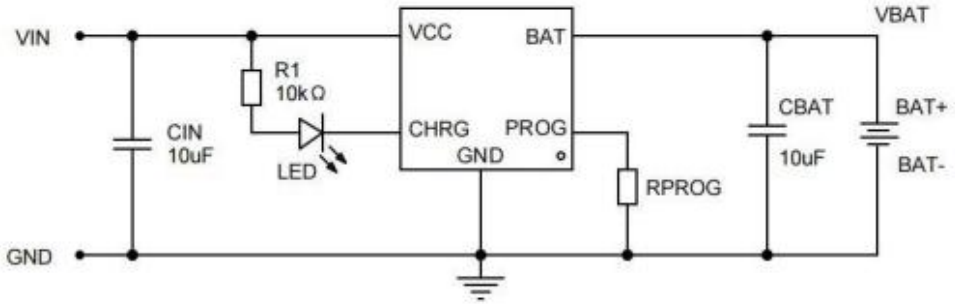


Figure 1. Without absorption circuit

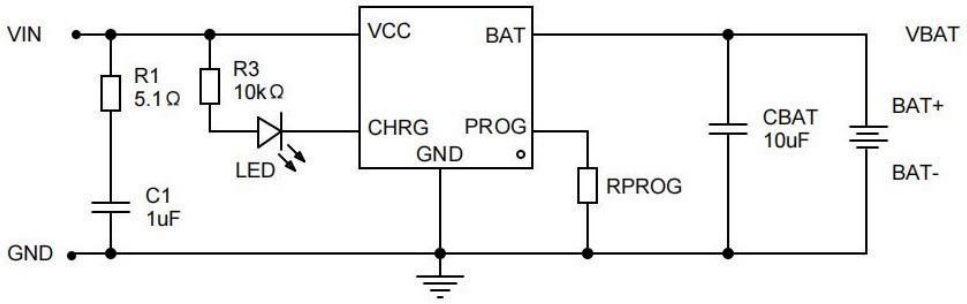
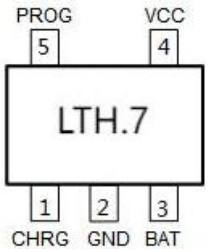


Figure 2. Add absorption circuit

Note: Figure 2 is designed for high surge impact environments， When customers choose to add absorption circuit design, it is recommended to use resistor packaging above 0603.

Pin Assignment



Model	Package	Silk Screen	Explain
CL4054HB	SOT23-5L	LTH.7	

Pin Number	Pin Name	Description
1	CHRG	Charge State Indicator
2	GND	IC Ground
3	BAT	Battery Voltage
4	VCC	Supply Voltage
5	PROG	CC Charge Current Setting & Monitor

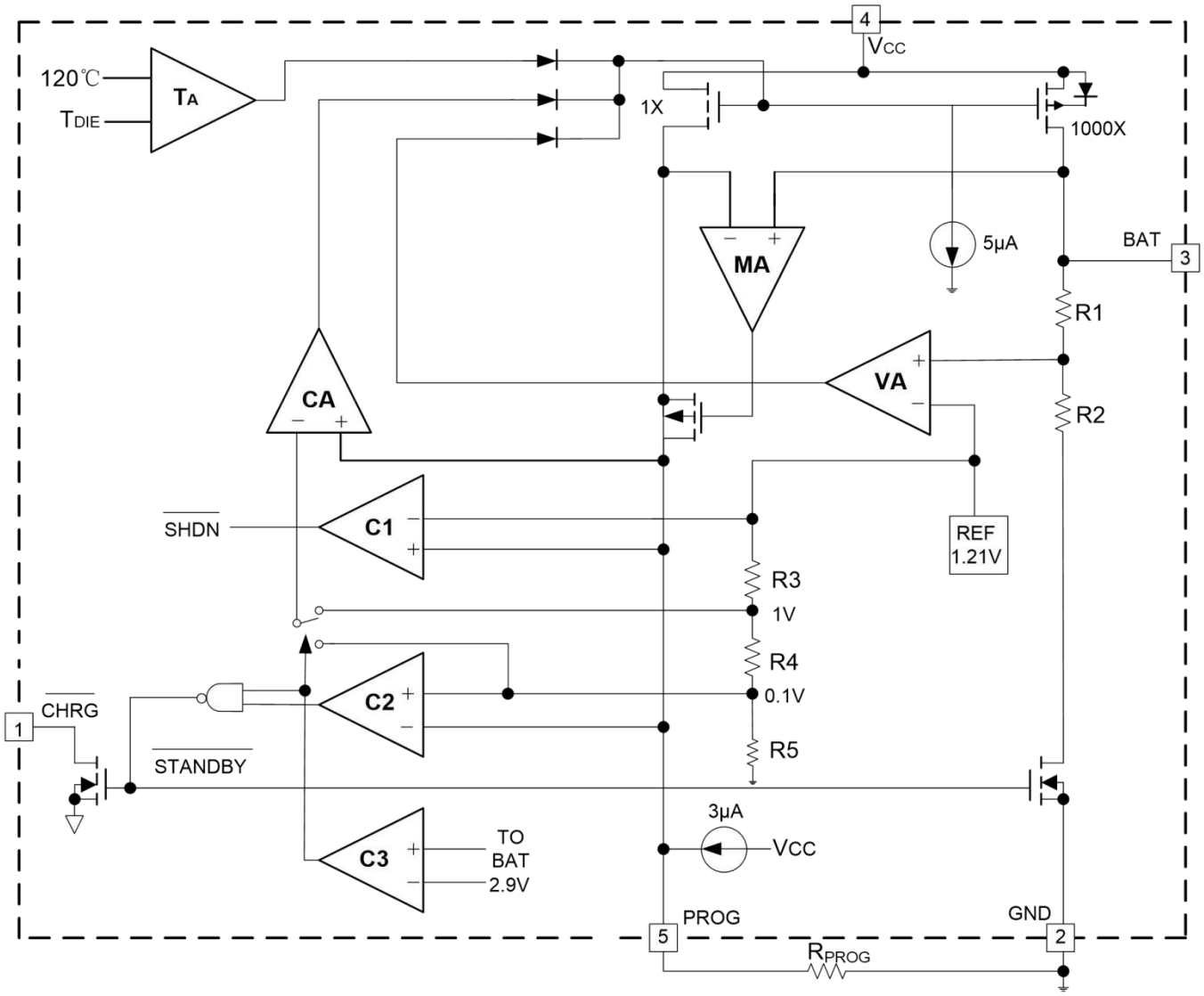
Absolute Maximum Ratings

Symbol	Parameter	Range	Unit
V_{CC}	Supply voltage	-0.3 ~ +36	V
V_{PROG}	PROG pin voltage	-0.3 ~ 8	V
V_{BAT}	BAT pin voltage	-0.3 ~ 10	V
V_{CHRG}	CHRG pin Voltage	-0.3 ~ +30	V
P_{DMAX}	Power consumption	250	mW
I_{BAT}	BAT pin current	500	A
I_{PROG}	PROG pin current	800	mA
V_{ESD}	HBM	4	kV
Latch-Up		400	mA
T_{OPA}	Operating Temperature	-40 to +85	℃
T_{STR}	Storage Temperature	-65 to +125	℃

Note 1:

The device may be damaged if the maximum range is exceeded. The device may operate within the recommended operating range, but its characteristics are not guaranteed. The DC and AC characteristics shown in the electrical characteristics are measured under specific conditions and their characteristics are guaranteed. This characterization assumes that the device is operating within the recommended operating range. Characteristics not shown do not guarantee performance. Typical values are best performance points.

Block Diagram



DC Electrical Characteristics

(Vcc=5V, TA= 25°C, unless otherwise noted)

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{CC}	Supply voltage		4.2		6.5	V
I_{CC}	Input current	Charge mode（R_{PROG}=12KΩ）（1）		240	500	μA
		Stand-by mode		45	90	μA
		Shut down mode（R_{PROG} not connected，V_{CC}<V_{BAT} or V_{CC}<V_{UV}）		25	50	μA
V_{FLOAT}	CV output (float) voltage	0℃<Ta<85℃	4.04	4.1	4.16	V
Vovp	Input voltage protection			6.5		V
I_{BAT}	BAT pin current	R_{PROG} = 12K, current mode	93	100	107	mA
		R_{PROG} = 2.4K, current mode	465	500	535	mA
		V_{BAT} = 4.24V, stand-by mode	0	-2.5	-6	μA
		Shut down		1	2	μA
		V_{BAT} = - 4V, battery reverse		0.7		mA
		V_{CC} = 0V, sleep mode		0	1	μA
I_{TRIKL}	Trickle charge current	V_{BAT}<V_{TRIKL}, R_{PROG} = 2.4K	40	50	60	mA
V_{TRIKL}	Trickle charge threshold Voltage	R_{PROG} = 12K, V_{BAT} rising	2.7	2.9	3.1	V
V_{TRHYS}	Trickle charge hysteresis voltage	R_{PROG} = 12K	60	80	110	mV
V_{UV}	V_{cc} under voltage lockout threshold	V_{cc} rising	3.6	3.8	4.0	V
V_{UVHYS}	V_{cc} under voltage lockout threshold hysteresis		150	200	300	mV
V_{MSD}	Manual shutdown threshold voltage	PROG rising	1.15	1.21	1.30	V
		PROG falling	0.9	1.0	1.1	V
V_{ASD}	V_{cc}-V_{BAT} lockout threshold	V_{cc} rising	70	100	140	mV
		V_{cc} falling	5	30	50	mV
I_{TERM}	C/10 termination comparator filter time (2)	R_{PROG} = 12K	0.085	0.10	0.115	mA/ mA
		R_{PROG} = 2.4K	0.085	0.10	0.115	
V_{PROG}	PROG pin voltage	R_{PROG} = 12K, current mode	0.93	1.0	1.07	V
V_{CHRG}	CHRG pin output low Voltage	I_{CHRG} = 5mA		0.35	0.6	V
ΔV_{RECG}	Battery recharge threshold voltage	V_{FLOAT}-V_{RECHRG}		100	200	mV
t_{RECHG}	Recharge comparator filter time	V_{BAT} high to low	0.8	1.8	4	ms
t_{TERM}	C/10 termination comparator filter time	I_{BAT} falling below I_{TERM}	0.63	1.4	3	ms
I_{PROG}	PROG pin pull-up current			2.0		μA

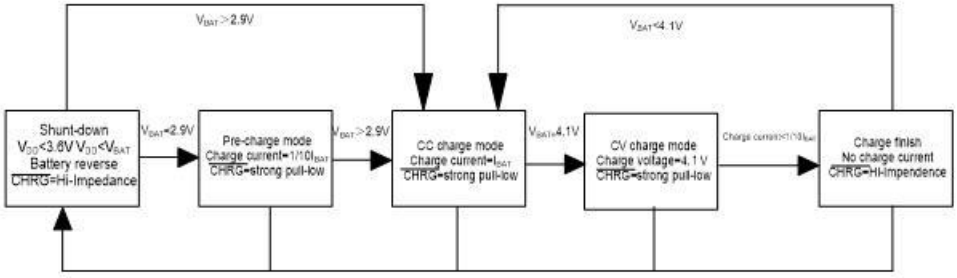
Notes

（1）: At this time it is charging, ICC=IVCC-IBAT.

（2）: C/10 termination current threshold refers to the ratio of the termination current to the constant current charging current.

Function Description

The CL4054HB is a single-cell Li-ion battery charger with a constant current/constant voltage algorithm. It can provide a maximum charge current of around 500mA (with a thermally well-designed PCB layout) and an internal P-channel power MOSFET and thermal regulation circuit. No blocking diodes or external current sense resistors are required.



Normal Charge Cycle

A charge cycle begins when the Vcc pin voltage rises above the UVLO threshold level and a 1% programmed resistor is connected between the PROG pin and ground or when a battery is connected to the charger output . If the BAT pin level is lower than 2.9V, the charger enters trickle charge mode. In this mode, the CL4054HB provides approximately 1/10 of the set charging current to boost the current to a safe level for full current charging.

When the BAT pin voltage rises above 2.9V, the charger enters constant current mode, which provides a constant charging current to the battery. When the BAT pin voltage reaches the final float voltage (4.1V), it enters the constant voltage mode and the charging current starts to decrease. The charging cycle ends when the charging current drops to 1/10 of the set value.

Setting of Charging Current

Charge current is programmed with a resistor connected from the PROG pin to ground. The current charging current is 1000 times the output current of the PROG pin. The setting resistor and charging current are calculated using the following formula.

The charging current output from the BAT pin can be determined at any time by monitoring the voltage of the PROG pin, the formula is as follows:

$$R_{PROG} = \frac{1200}{I_{BAT}}$$

The reference table for the relationship between RPROG and charging current is as follows:

RPROG(K)	IBAT(mA)
2.4	500
4	300
12	100

Battery Reverse Polarity Protection

CL4054HB has lithium battery reverse connection protection function. The positive and negative poles of the high-grade lithium battery are reversely connected to the current output pin of CL4054HB. CL4054HB will stop and display a fault state without charging current. In the case of reverse connection, the power supply voltage should be around the standard voltage of 5V and should not exceed 8V. If the power supply voltage is too high, the chip

voltage difference will exceed 10V when the battery voltage is reversed, so the power supply voltage should not be too high in the case of reverse connection.

Charge Status Indicator (CHRG)

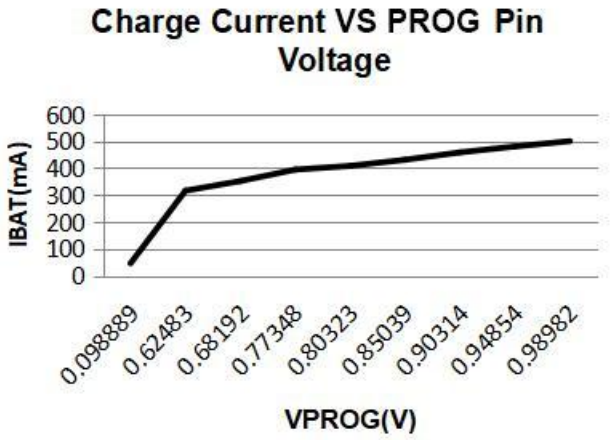
CL4054HB has an open-drain status indication output "CHRG". When the charger is in the charging state, CHRG is pulled to a low level, and in other states, CHRG is in a high-impedance state. When the battery is not connected to the charger, CHRG outputs a pulse signal to indicate that the battery is not installed. When the external capacitance of the BAT pin of the battery connection terminal is 10uF, the CHRG flashing period is about 0.5-2 seconds. When the status indication function is not used, connect the unused status indication output terminal to ground.

With battery charging indicator status	CHRG
Normal state of charge	Constant on
Battery full state	Off
The battery is reversed, the power supply is undervoltage	Off
Power on without battery	Flashing

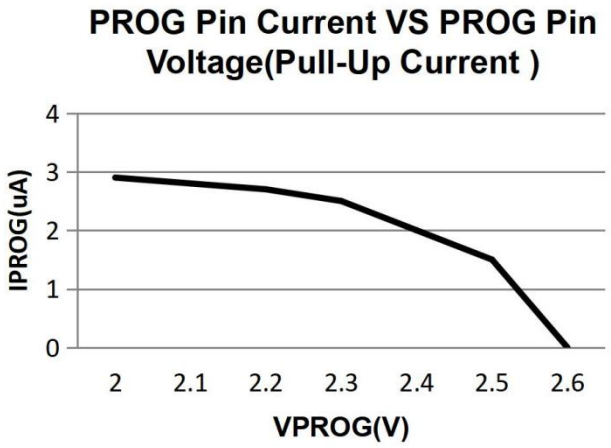
Thermal

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 prevents the CL4054HB from overheating and allows the user to increase the upper limit of a given board's power handling capability without risking damage to the CL4054HB. Under the premise of guaranteeing that the charger will automatically reduce the current under worst-case conditions, the charging current can be set according to the typical (not worst-case) ambient temperature. Power considerations for the SOT-23-5L are discussed further in the Thermal Considerations section.

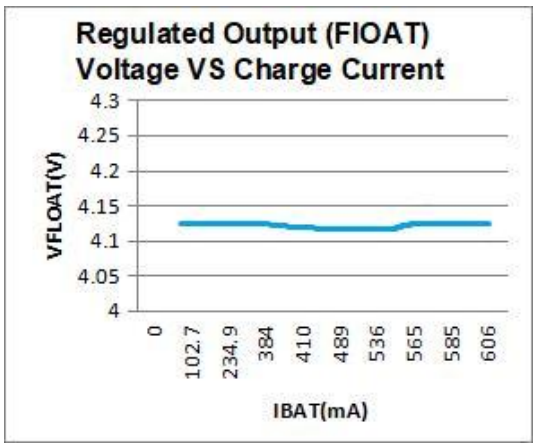
Characteristic Curves



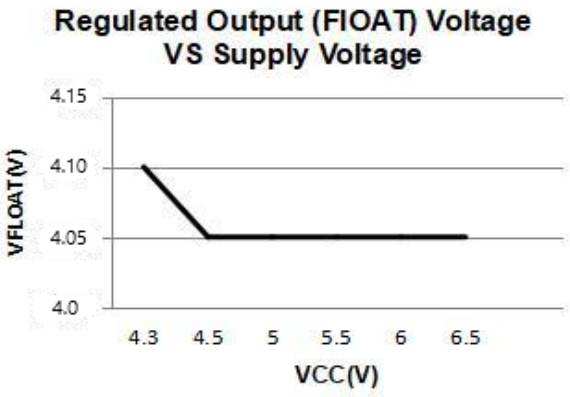
Relationship curve between charging current and PROG pin voltage



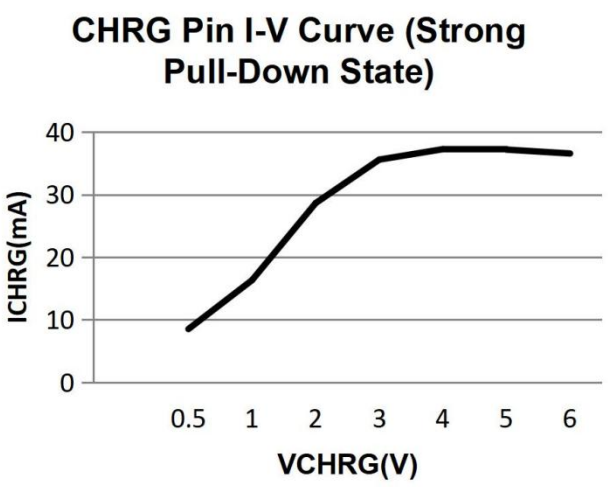
Relationship curve between PROG pin voltage and PROG pull-up current



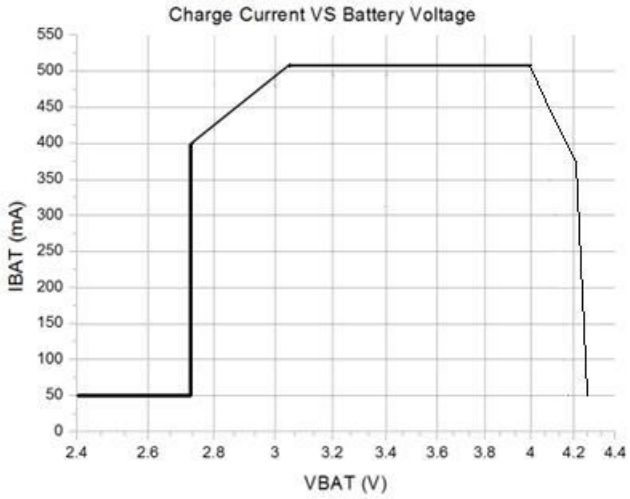
The relationship between float charging voltage and charging current



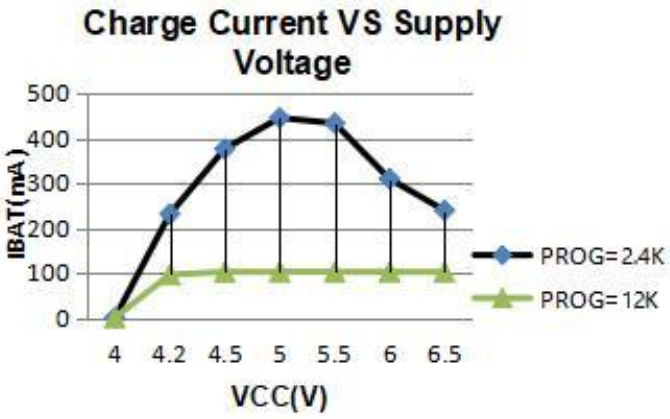
The relationship between float charging voltage and power supply voltage



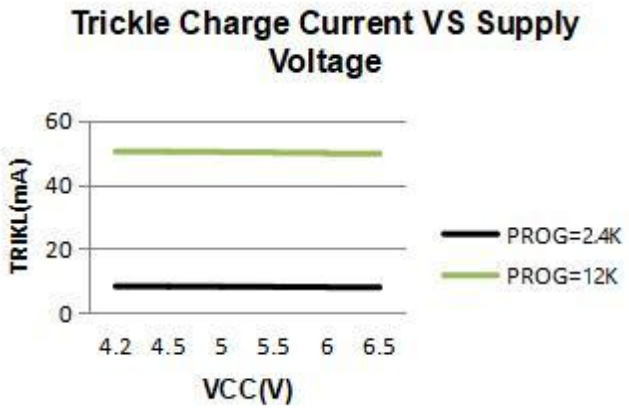
Relationship between charging voltage and charging current



I-V Curve

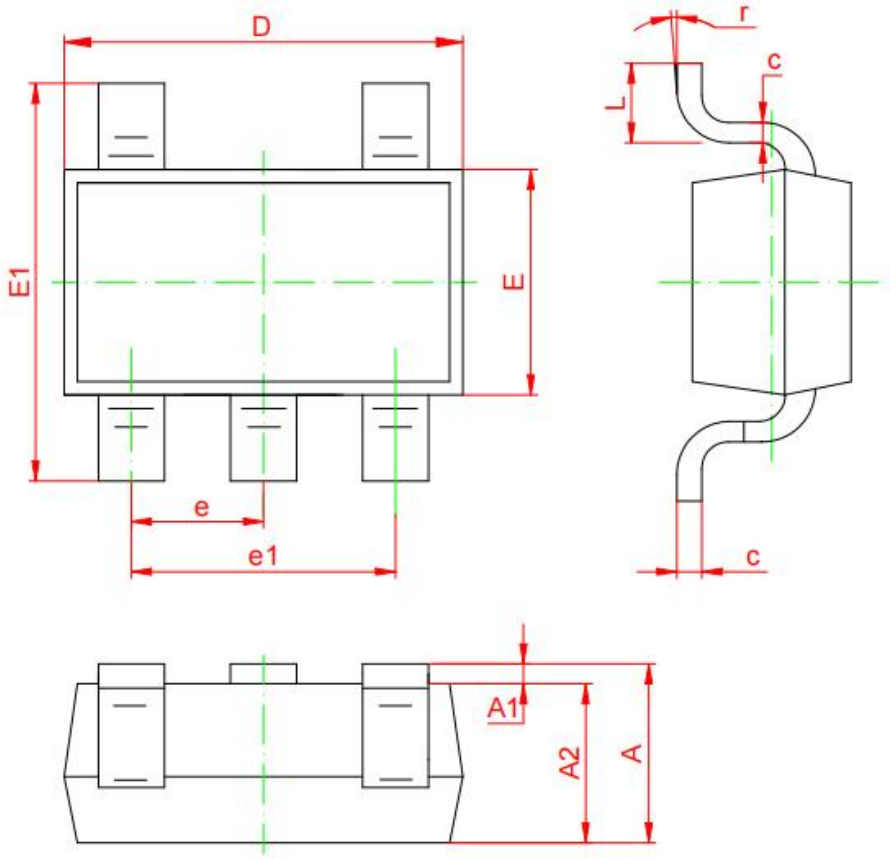


The relationship between charging current and power supply voltage



Relationship between Trickle Current and Power Supply Voltage

Package Information: SOT23-5L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 (BSC)		0.037 (BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
r	0°	8°	0°	8°

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