1.0A Linear battery management chip with **USB** interface compatible

ÿ Product Overview

LN4056H is a single-cell rechargeable lithium battery capable of constant current/constant voltage charging. Electric charger circuit components. The device includes power transistors inside, applications No external current sense resistors and blocking diodes are required. LN4056H only It requires very few peripheral components and conforms to the USB bus technical specification. Suitable for the field of portable applications.

The thermal modulation circuit can be used when the power consumption of the device is relatively large or the ambient temperature is relatively Control the chip temperature within a safe range when it is high. Internally fixed constant pressure charge The electrical voltage is 4.2V, which can also be adjusted by an external resistor. recharging current Set by an external resistor. When the input voltage (AC adapter or USB When the power is turned off, the LN4056H automatically enters a low-power sleep mode. The current consumption of the battery is less than 0.1μA. When the battery voltage is higher than the input voltage, the automatic automatically turn off the built-in power MOSFET. Other features include low input voltage lockout storage, automatic recharge, battery temperature monitoring and charge status/end of charge status instructions, etc. The LN4056H can be turned off charging through the enable pin, the shutdown state The static power consumption of the chip in the state is below 20uA; the chip has reverse battery protection;

The LN4056H is available in a thermally enhanced 8-pin small outline package ESOP8ÿ

ÿ Purpose

ÿ Mobile phone

ÿ Digital camera

ÿ MP4 player

ÿ Bluetooth application

ÿ Electronic dictionary

ÿ Portable equipment

ÿ Various chargers

ÿ Power bank

ÿ Product Features

ÿ Programmable charging current up to 1.0A

ÿ No need for external MOSFET, sense resistor and blocking diode

ÿ Small size enables fully linear charge management for Li-ion batteries

ÿ Constant current/constant voltage operation and thermal regulation make battery management most effective high, no danger of overheating

ÿ Manage monolithic Li-Ion battery from USB interface

ÿ Charge current output monitoring

ÿ Charging status indicator and full status indicator

ÿ 1/10 charge current termination

ÿ Automatic recharge ÿ

Provide 40ÿA current when stop working

ÿ 2.9V Trickle Charge Threshold Voltage

ÿ Soft start to limit inrush current

ÿ Battery reverse polarity protection

ÿ When the VIN is unplugged, the IC does not consume battery power

ÿ Adopt ESOP8 and customized package form

ÿ Package

ÿ ESOP8

ÿ Typical circuit

ÿConstant current/constant voltage **4.2V** charging application

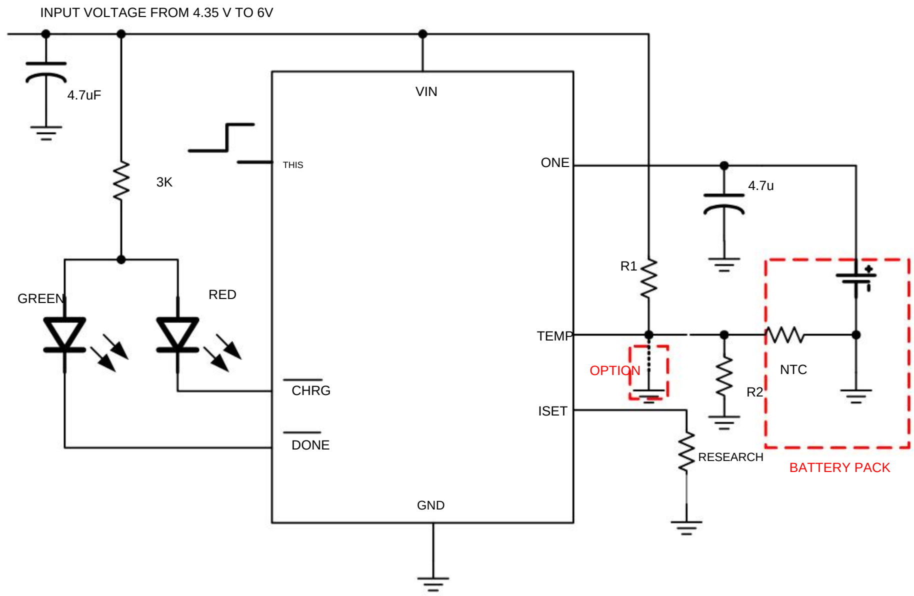
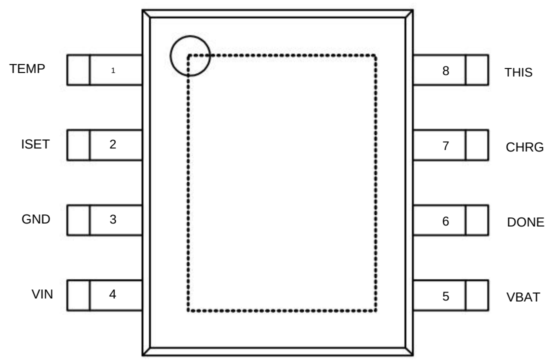


figure 1

ÿ Pin Configuration



ESOP-8

(Top View)

ÿ Pin function

ÿ TEMP (pin 1): connect the TEMP pin to the output of the NTC sensor of the battery. If the voltage of the TEMP pin is less than 30% of the input voltage or greater than the input voltage 60% of the voltage means that the battery temperature is too low or too high, and charging will be suspended. If TEMP is between 30% and 60% of the input voltage, the battery fault condition will is cleared and charging will continue.

ÿ ISET (pin 2): charging current programming, charging current monitoring and shutdown terminal. Charge current is controlled by a 1% accurate resistor to ground. at constant charge current In state, this port provides 1V voltage. In all states, this port voltage can be used to calculate the charging current using the following formula.

IBAT = (SHOTS/RISES) ×960

The ISET port can also be used to turn off the charger. The programming resistor is separated from the ground terminal, and the ISET port voltage can be pulled up by the pull-up 3μA current source inside the chip. When the limit shutdown voltage value of 1.21V is reached, the acting device enters the shutdown state, charging ends, and the input current drops to 25μA. This port pinch-off voltage is about 2.4V. By combining the ISET resistor and ground, the charger returns to its normal state.

ÿ GND (pin 3): ground terminal, EXPOSED pin also needs to be connected to pin 3.

ÿ **VIN** (Pin 4): Provides positive voltage input. The VIN pin must have a bypass capacitor of at least 1μF. When VIN falls within 30mV of BAT terminal voltage, LN4056H stops When charging, the current consumption of the BAT port is less than 0.1uA.

ÿ **BAT** (Pin 5): Connect the positive terminal of the battery to this pin. At full charge, if VIN is not removed, BAT consumes about 2uA. During charging,

If VIN is removed, the current consumption of the BAT pin is less than 0.1uA.

ÿ DONE (pin 6): When charging is over, the DONE pin is pulled to a low level by the internal switch, indicating that charging has ended; otherwise, the DONE pin is in a high-impedance state.

ÿ CHRG (pin 7): When the charger is charging the battery, the CHRG pin is pulled to a low level by the internal switch, indicating that charging is in progress; otherwise, the CHRG pin is at a high level

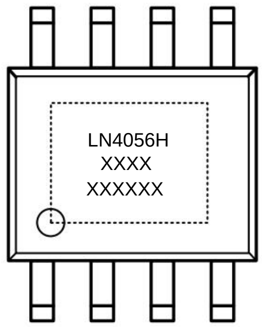
resistance state.

ÿ CE (pin 8): This pin can control whether the chip is charged or not. Connect to a high level to enable charging, and a low level to turn off charging. The static power consumption of the chip is 20uA after turning off charging.

Less than;

ÿ Printing information

ÿ **ESOP8**



ESOP8
(TOP VIEW)

The second and third lines represent the version number and quality information, as defined by production.

ÿ Absolute Maximum Ratings

parameter	label	maximum rating	unit
Input voltage	Vcc	-0.3ÿ+7	IN
ISET terminal voltage	SHOWN	-0.3 ÿ VIN + 0.3	
BAT terminal voltage	Vbat	-0.3ÿ6	
DONE terminal voltage	Vdone	-0.3ÿ+7	
CHAG terminal voltage	Vchrg	-0.3ÿ+7	
BAT terminal current	Ibat	1500	mA
Working ambient temperature	Topa	-40ÿ+85	°C
storage temperature	Tstr	-65ÿ+125	

NOTE: Absolute Maximum Ratings are ratings that must not be exceeded under any conditions. Exceeding this rating may cause physical damage such as product deterioration.

ÿ Functional block diagram

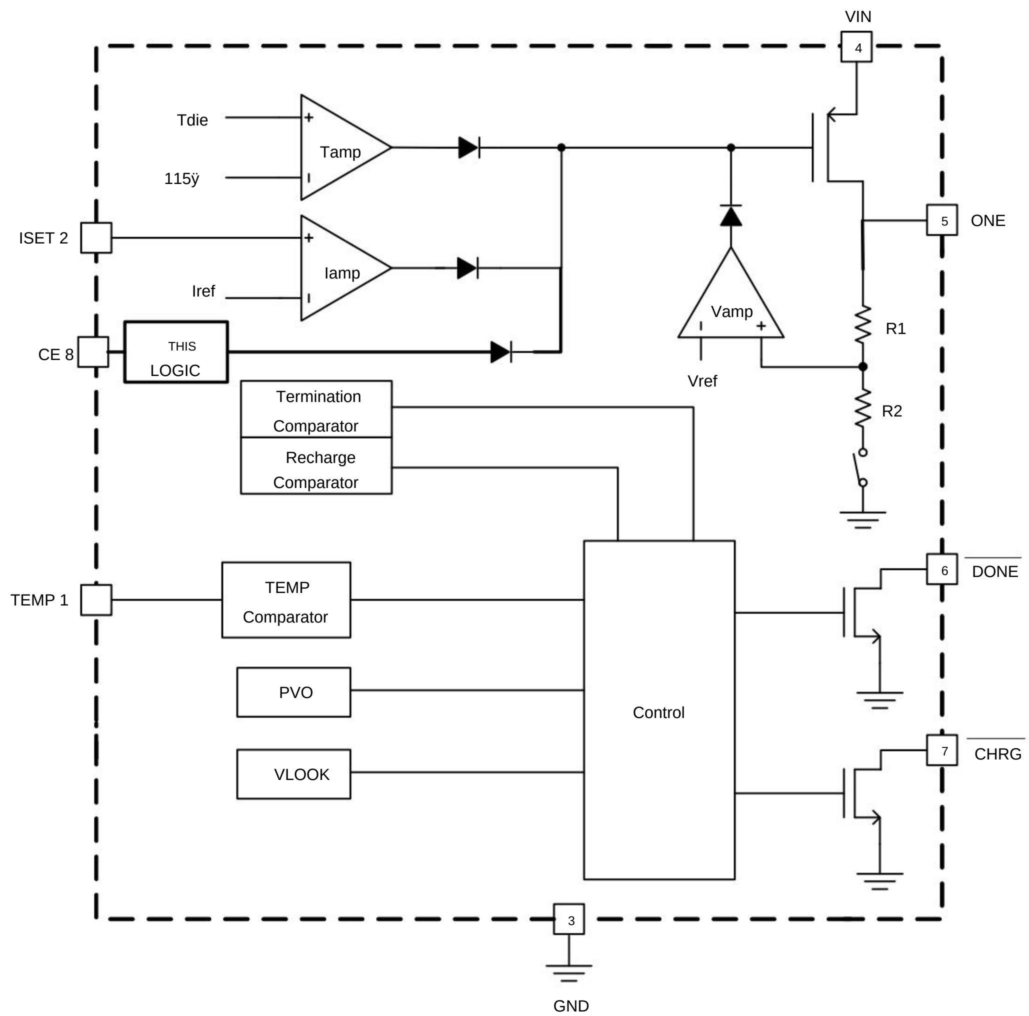


image 3

ÿ Electrical characteristic parameters

(Ta=25ÿ, unless otherwise specified)

parameter	label	condition	Lowest	Typical	Highest	Unit
Input voltage	Vcc	-	4.25	-	6.5	IN
Input Current	Icc	Charge mode,Research=10K	-	200	2000	μA
		Standby mode	-	20	30	μA
		Shutdown mode1(Riset not connected,Vcc<Vbat or Vcc<Vuv)	-	50	100	μA
		Shutdown mode1ÿCE=0ÿ		20		μA
output control voltage	Vfloat	0 TAÿ85 ÿ, IBAT = 40mA 4.16 4.2			4.25	IN

BAT terminal current	Ibat	Riset=10k,Current mode	86	96	106	mA
		Riset=1k,Current mode	882 960		1038	mA
		Standby mode,Vbat=4.2V	0	-2.5	-6	μA
		Shutdown mode	-	-	1	μA
		Battery reverse mode, VBAT=-4V	-	0.7	-	mA
		Sleep mode,Vcc=0V	-	-	0.1	μA
Trickle Charge Current	Itrikl	Vbat <Vtrikl, Rprog = 2k	76	96	116	mA
Trickle charge limit voltage	Vtrikl	Research=10KÿVbat Rising	2.8	2.9	3.0	IN
Trickle Charge Hysteresis Voltage	Vtrhys	Research=10k	60	80	120	mV
Power Low Lockout Threshold Voltage	Vuv	From Vcc low to high	3.7	3.8	3.93	IN
Supply Low Threshold Voltage Hysteresis Voltage	Vuvhys	-	150 200		300	mV
Manual shutdown threshold voltage	Vmsd	Iset pin rising	1.15 1.21		1.30	IN
		Iset pin falling	0.9	1.0	1.1	IN
Vcc-Vbat stop working threshold voltage	Vasd	Vcc from low to high	70	100	140	mV
		Vcc from high to low	5	30	50	mV
C/10 Termination Threshold Current	Iterm	Research=10k	8	10	12	mA
		Riset=2k	40	50	65	mA
PROG terminal voltage	Vprog	Riset=10k, Current mode	0.93	1.0	1.07	IN
DONE terminal minimum output voltage	Vdone	Eye = 5mA	-	0.35	0.6	IN
CHRG terminal minimum output voltage	Vchrg	Ichrg=5mA	-	0.35	0.6	IN
Battery recharge hysteresis voltage ÿ	Vrecg	VFLOAT - VRECHRG	-	150	200	mV

ÿ Application Information

ÿ Set the charging current

In constant current mode, the formula for calculating the charging current is: ISET= 960V / RISET. Among them, ISET represents the charging current, the unit is ampere, RISET represents the ISET tube Resistance from pin to ground, in ohms. For example, if a charging current of 500 mA is required, it can be calculated as follows: RISET = 960V/0.5A = 1.98Kÿ

To ensure good stability and temperature characteristics, RISET recommends using metal film resistors with an accuracy of 1%.

ÿ Battery temperature monitoring

In order to prevent damage to the battery caused by high or low battery temperature, the LN4056H integrates a battery temperature monitoring circuit. Battery temperature monitoring is done by measuring The voltage at the TEMP pin is achieved by the NTC thermistor in the battery and a resistor divider network, as shown in Figure 3.

The LN4056H compares the voltage of the TEMP pin with two thresholds VLOW and VHIGH inside the chip to confirm whether the temperature of the battery exceeds the normal range. exist Inside the LN4056H, VLOW is fixed at 30%×VIN, and VHIGH is fixed at 60%×VIN. If the voltage of the TEMP pin is VTEMP<VLOW or VTEMP>VHIGH ,

If the battery temperature is too high or too low, the charging process will be suspended; if the voltage VTEMP on the TEMP pin is between VLOW and VHIGH , the charging cycle will continue.

ÿ Determine the value of **R1** and **R2**

The values of R1 and R2 should be determined according to the temperature monitoring range of the battery and the resistance value of the thermistor. Now an example is given as follows: Suppose the set battery temperature range is TL~

TH, (where TL<TH); the negative temperature coefficient thermistor (NTC) is used in the battery, RTL is its resistance at temperature TL, and RTH is its resistance at temperature TH.

resistance value, then RTL>RTH, then, at the temperature TL, the voltage at the TEMP end of the first pin is:

$$IN_{TEMPL} = \frac{R_2 // R_{TL}}{R_1 + R_2 // R_{TL}} \times Vin$$

At temperature TH, the voltage at the first pin TEMP is:

$$IN_{TEMPH} = \frac{R_2 // R_{TH}}{R_1 + R_2 // R_{TH}} \times Vin$$

Then, by $V_{TEMPL} = V_{HIGH} = K2 \times V_{IN}$ (K2 0.6)

$In_{TEMPH} = V_{LOW} = K1 \times V_{IN}$ (K1 0.3)

can be solved: $$R1 = \frac{R_{TL} R_{TH} (K2 \; K1)}{(R_{TL} \; R_{TH}) K1K2}$$

$$R2 = \frac{R_{TL} R_{TH} (K2 \; K1)}{R_{TL}(K1 \; K1K2) \; R_{TH}(K2 \; K1K2)}$$

Similarly, if the inside of the battery is a positive temperature coefficient (PTC) thermistor, then RTH>RTL, we can calculate:

$$R1 = \frac{R_{TL} R_{TH} (K2 \; K1)}{(R_{TH} \; R_{TL}) K1K2}$$

$$R2 = \frac{R_{TL} R_{TH} (K2 \; K1)}{R_{TH}(K1 \; K1K2) \; R_{TL}(K2 \; K1K2)}$$

It can be seen from the above derivation that the temperature range to be set has nothing to do with the power supply voltage VIN , but is only related to R1, R2, RTH and RTL ; among them, RTH and RTL can be

Obtained by consulting the relevant battery manual or through experimental testing.

In practical applications, if you only pay attention to the temperature characteristics of one end, such as overheating protection, then R2 can be omitted, and only R1 can be used. The derivation of R1 also becomes very simple,

It is not repeated here.

ÿ Open-drain status indication output

LN4056H has two open-drain status indication terminals, CHRG and DONE, which can drive LEDs or microcontroller ports. For CHRG

When charging, CHRG is low level; DONE is used to indicate charging end state, when charging is over, DONE is low level. When the temperature of the battery

When outside the normal temperature range for more than 0.15 seconds, the CHAG and DONE pins both output a high impedance state.

When the battery is not connected to the charger, the charger will quickly charge the output capacitor to the constant voltage charging voltage value. Since the battery voltage Kelvin detects the leakage current of the BAT pin,

The voltage of the BAT pin will slowly drop to the recharge threshold, so that a waveform with a ripple voltage of 150mV is formed at the BAT pin, and the CHAG output pulse signal meter

indicates that no battery is installed. When the external capacitance of the battery connection terminal BAT pin is 4.7μF, the period of the pulse is about 2Hz.

The following table lists the states of the CHAG and DONE pins under various conditions:

state	Charge	full	no battery	error
CHAG	Always bright	Always off	Blinking	Always off
DONE	Always off	and always on	solid	Always off

Note: 1. The flickering frequency of CHAG is related to the external capacitor when there is no battery. Generally, 4.7μF is recommended. The larger the capacitor, the smaller the flickering frequency.

2. The error conditions include: exceeding the working temperature range (temperature is too high or too low), the Iset terminal is floating, Vin<Vbat, Vin<3.8V, etc.

ÿ High current output design

Since the LN4056H adopts the internal constant power technology, when the voltage difference between the input VIN and BAT is too large, the BAT voltage range of the maximum current will become smaller, from

The charging time will be longer. In order to increase the maximum current charging range, an external resistor or Schottky method can be used to achieve it.

Assume that the maximum allowable power inside the ESOP8 package of the LN4056H is 1.2W, and the maximum charging current is set to 1.0A. If resistors are used, we assume that

It is a 0.5 ohm (1W) resistor. When charging with a large current, the voltage drop across the resistor is 0.5*1.0=0.5V. The real working voltage of LN4056H is 4.4V. Therefore, in this state

Lower, (VIN-VBAT)*1.0<1.2W, so VBAT>3.4V, the battery voltage above 3.4V supports 1.0A charging, below 3.4V, the LN4056H will automatically reduce

Small charging current to maintain the internal power balance of the chip.

If a Schottky is used, a similar calculation can be made based on the Schottky's voltage drop at different currents.

In addition, in high-current applications, it is necessary to pay attention to the **LN4056H** when designing the **PCB** layout, must consider increasing the area of the EXPOSED PAD, and connect the **EXPOSED PAD**

Connect to **GND** to improve the heat dissipation performance and ensure the stable operation of the chip.

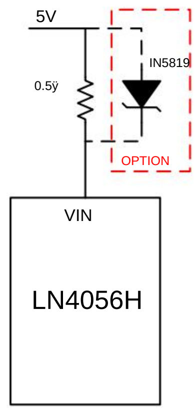
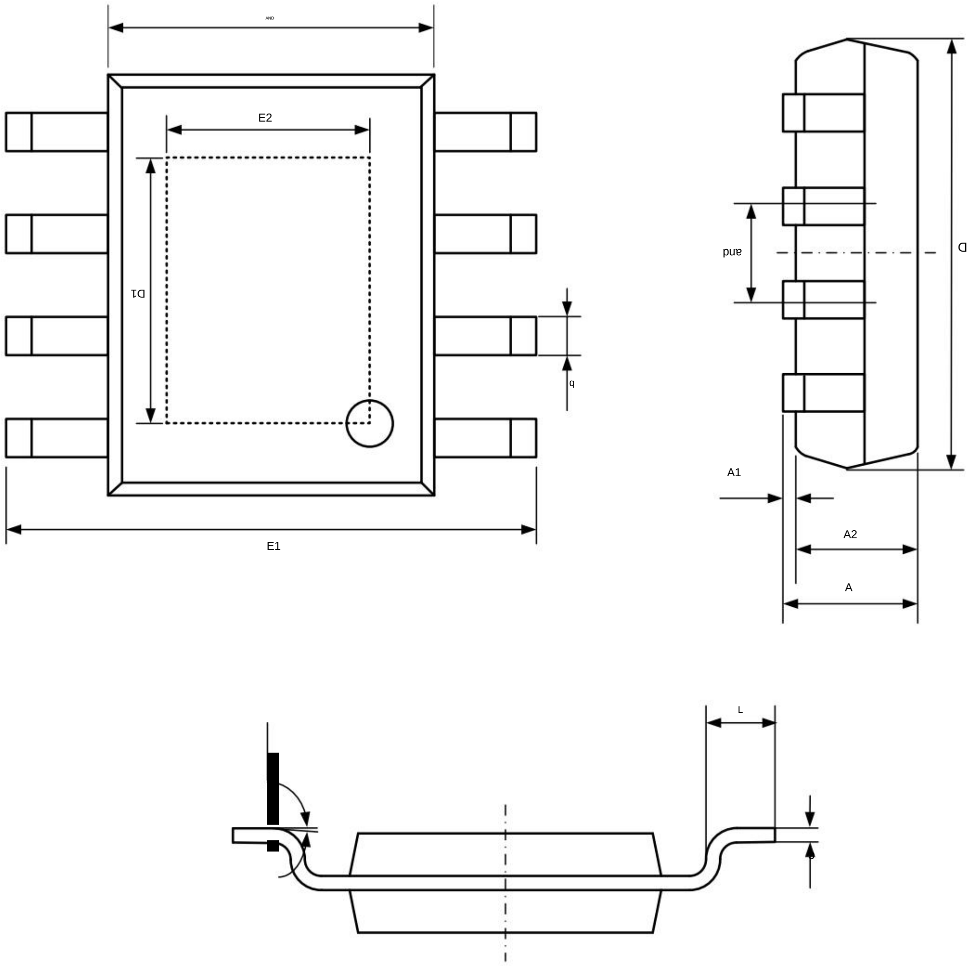


Image 6

ÿ Package information

ÿ **ESOP8**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	0.002	0.006
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
D1	3.202	3.420	0.126	0.134
AND	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
and	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
i	0°	8°	0°	8°