1A Linear Lithium Battery Charger Management IC with 48V Input Voltage

1 Features

- Input withstand voltage 48V
- Charge target voltage: 4.2V, support custom full voltage range: 4.05V~4.4V (step=50mV)
- Support customized lithium iron phosphate battery, charge target voltage range: 3.5V~3.8V (step=50mV)
- Maximum 1A charging current
- Optional external resistance setting charging current function or NTC function (choose one of two)
- Full stop charge detection current is 30mA
- Trickle charging current is 1/5 constant current charging current
- BAT Standby current 50nA
- Soft start to limit inrush current
- Support LED charging status indicator, support constant current function (can omit LED current limiting resistance)
- Support battery reverse protection
- Support a variety of protection functions: IC overtemperature protection, input undervoltage protection, input overvoltage protection, NTC protection (IP4048_NTC model support)
- Package DFN8L-2X3

2 Typical Applications

- Low power handheld devices

3 Description

IP4048 is an IC that supports linear charge management of single lithium battery with an input withstand voltage of 48V.

IP4048 integrates power MOS, only needs very few peripheral devices, effectively reduces the size of the overall scheme and BOM cost.

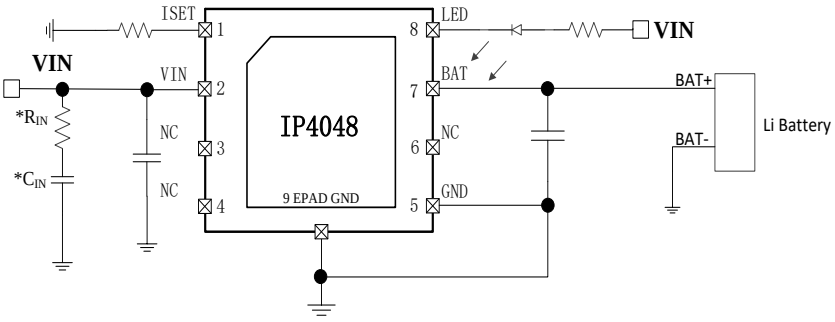
IP4048 features a complete triple charging process of Trickle Charge (TC), Constant Current (CC) and Constant Voltage (CV) charging; the Trickle Charge (TC) stage pre-charges the battery to restore a fully discharged battery; the Constant Current (CC) mode safely delivers a buck fast charge; and the final stage, Constant Voltage (CV) charging mode, ensures that the battery's full capacity is safely reached.

IP4048 has an input undervoltage protection function that intelligently adjusts the charging current and adapts to the load capacity of the adapter to prevent adapter failure.

IP4048 supports ISET pin external connection resistor to set charging current, or customized to NTC function

IP4048 is packaged in DFN8L-2X3

4 Simplified Application Schematic



***Add *CIN,*RIN for more than 20V plugging.**
Recommended *CIN=1uF,*RIN=5.1R

Figure 1 IP4048 Simplified Application Schematic

Directory

5 Modify records

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6 Common Model

Type name	Function
IP4048	The standard model ISET pin is ISET function without NTC function
IP4048_SOD_3.95V	Based on the standard model, the full voltage is modified to 3.95V and the trickle to constant current is customized to 2.6V.
IP4048_NTC	The ISET pin is NTC function,without ISET function
IP4048_NTC_1A	Modify the charging current to 1A based on IP4048_NTC
IP4048_EN_7M	Based on the standard model, the ISET pin is customized to EN function, and the charging current is modified to 700mA.
IP4048_EN_8M	Based on the standard model, the ISET pin is customized to EN function, and the charging current is modified to 800mA.
IP4048_EN_1A	Based on the standard model, the ISET pin is customized to EN function and the charging current is modified to 1A
IP4048_EN_7M_4V35	Based on the standard model, the ISET pin is customized to EN function, the charging current is modified to 700mA, the full voltage is modified to 4.35V, the trickle current is modified to 1/10 of the constant current, and the full stop charging detection current is modified to 50mA.
IP4048_EN_8M_4V35	Based on the standard model, the ISET pin is customized to EN function, the charging current is modified to 800mA, the full voltage is modified to 4.35V, the trickle current is modified to 1/10 of the constant current, and the full stop charging detection current is modified to 50mA.
IP4048_CT	Opening of the temperature ring on the basis of the standard model。
IP4048_NTC_CT	Open temperature loop based on IP4048_NTC
IP4048_EN_7M_4V35_CT	Open temperature loop based on IP4048_EN_7M_4V35
IP4048_EN_8M_4V35_CT	Open temperature loop based on IP4048_EN_8M_4V35

7 PIN Description

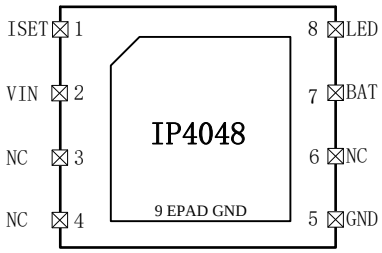


Figure 2 Pin of IP4048

Pin No.	Pin Name	Pin Description
1	**ISET**	Constant current charging setting pin, can be customized to NTC pin
2	**VIN**	Input pin, connect 5V charging input
3	**NC**	
4	**NC**	
5	**GND**	Power Ground
6	**NC**	
7	**BAT**	Battery connection pin, connected to the positive electrode of the battery
8	**LED**	Charging indicator LED, support constant current function (can omit LED current limiting resistor)
9(EPAD)	**GND**	Power Ground

8 Functional Block Diagram

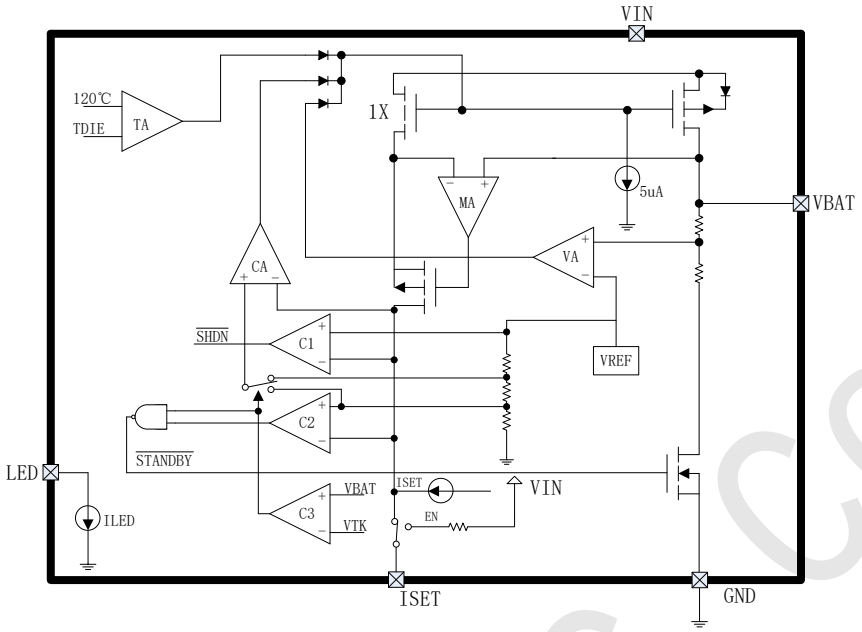


Figure 3 IP4048 Functional Block Diagram

9 Limit parameters

Parameters	Symbol	Value	Unit
Input port voltage range	V_{IN}	-0.3 ~48	V
Battery port voltage range	V_{bat}	-6 ~ 7.5	V
Junction temperature range	T_J	-40 ~ 150	℃
Storage temperature range	T_{stg}	-65 ~ 150	℃
Thermal resistance (junction temperature to environment)	θ_{JA}	220	℃/W
Human Body Model (HBM)	ESD	4	KV

*Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.

10 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	VIN	4.5	5	5.5	V
Charge Current	IOUT			1	A

* Devices' performance cannot be guaranteed when working beyond those Recommended Operating Conditions.

11 Electrical Characteristics

Unless otherwise specified,T_A=25℃,V_{IN}=5V

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Charging System						
Input Voltage	V_{IN}		4.5	5	5.5	V
Input under-voltage threshold	V_{IN-UV}			V_{BAT} +0.4		V
Input over-voltage threshold	V_{IN-OV}			6		V
Input overvoltage protection hysteresis				200		mV
Input Current	I_{VIN}	VIN=5V，VBAT=NC，NO LED		1	2	mA
Standby Current	$I_{standby-BAT}$	VIN=0V，VBAT=3.7V，NO LED		50	2000	nA
		VIN=0V，VBAT=-6V，NO LED		1	2s	mA
Charge Current	I_{CC}	R_{ISET}=1K	0.9	1	1.1	A
		R_{ISET}=NC（≥120K）	0.45	0.5	0.55	A
Charge Target Voltage	V_{CV}	VIN=5V	4.16	4.2	4.24	V
Full charge stop detection voltage	V_{SV}			V_{CV}-0.05		V
Charging voltage after full charge	V_{RC}			V_{CV}-0.1		V
Trickle over constant current voltage	V_{TK}	VIN=5V	2.9	3.0	3.1	V
Trickle Charge Current	I_{TK}	VIN=5V，VBAT<2.9V		1/5 I_{CC}		mA
Charge Cut-off Current	I_{STOP}			30	50	mA
Control System						
LED drive Current	I_{Led}	VIN=5V			5	mA
Thermal shutdown temperature	T_{OTP}	Rising Threshold	100	110	120	℃
Thermal shutdown recovery temperature	T_{OTP-H}	Falling Threshold	80	90	100	℃

12 Function Description

12.1 Charge Process

The IP4048 uses a full trickle/constant/constant voltage charging mode.

When the battery voltage is less than the trickle to constant current voltage V_{TK}, it is charged with trickle charging current I_{TK}.

When the battery voltage is greater than V_{TK}, charge with constant current charging current I_{CC}.

When the battery voltage approaches the set constant voltage charging voltage V_{CV}, the charging voltage V_{CV} remains unchanged, the charging current slowly decreases, and the constant voltage charging mode is entered.

After entering the constant voltage charging mode, if the charging current is less than the full charge stop detection current I_{STOP}. The charging will be stopped first, and then detect whether the battery voltage is higher than the stop voltage V_{SV}. If it is higher than the charging stop voltage V_{SV}, stop charging. If the stop voltage is lower, charging continues.

After the battery is fully charged and stopped, and the input VIN continues to be active, if the battery voltage is less than V_{RC}, it will enter the full charge stage and start the charging process again.

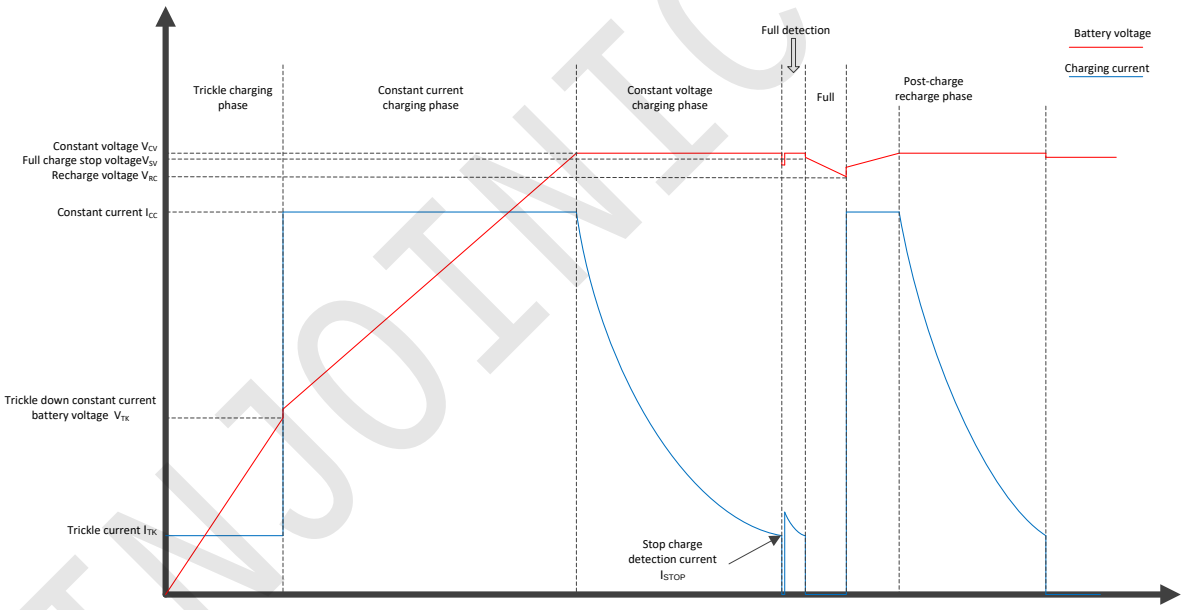


Figure 4 IP4048 Schematic diagram of the charging process

12.2 Charging protection

IP4048 has perfect protection function, integrated input under voltage, input over voltage, IC over temperature protection and other functions to ensure stable and reliable work of the system.

The IP4048 has an input VIN withstanding voltage of 48V and will stop charging if the input VIN is greater

than 6V.

The IP4048 features VIN input undervoltage protection, which automatically adjusts to reduce the charging current when it detects that the input voltage is close to VBAT+0.4V, ensuring that it does not pull the adapter.

IP4048 integrated over-temperature protection function, when the internal temperature of the chip is detected to exceed 110 degrees, it will be forced to stop charging.

12.3 Charge current setting

The IP4048 standard product supports this function

IP4048 supports ISET pin to set the charging current, external resistor RISET to set the constant charging current;

The relationship between constant current and RISET :I_{CC}=1000/R_{ISET}.

RISET resistance（Ω）	constant charging current
1K	1A
2K	0.5A
10K	0.1A
NC（≥120K）	0.5A

12.4 NTC

The IP4048_NTC model supports the NTC function (the IP4048_NTC does not support the ISET pin to set the charge current function)

IP4048_NTC supports NTC protection function which can cooperate with NTC resistance to detect battery temperature;

By default, 100uA current is discharged, and when the pin voltage is detected to be greater than 1.5V (NTC resistance is greater than 15K), the output current is reduced to 30uA; at the output of 30uA, when the pin voltage is detected to be less than 0.3V (NTC resistance is less than 10K), the output current changes to 100uA.

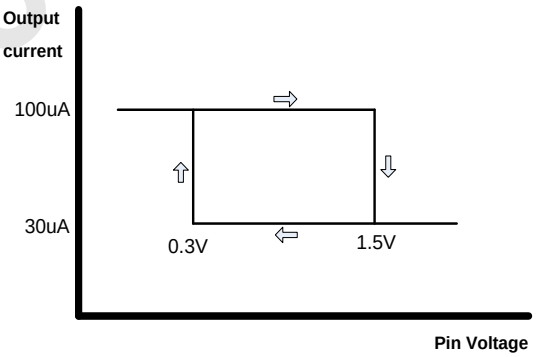


Figure 5 Pin output current vs. pin voltage

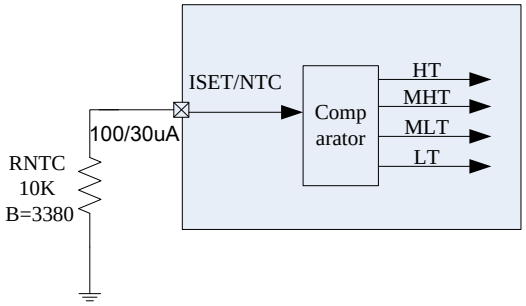


Figure 6 NTC Diagram

When IP4048 detects that the NTC pin voltage rises to greater than 0.82V@30uA (below 0℃), it triggers low-temperature protection and stops charging;

When IP4048 detects that the NTC pin voltage is between 0.54V@30uA~0.82V@30uA (0℃~10℃), it triggers the medium-low temperature protection and the charging current is reduced to half;

When IP4048 detects NTC pin voltage between 0.49V@100uA~0.54V@30uA (10℃~45℃), it indicates that the battery temperature is normal and normal charging;

When IP4048 detects NTC pin voltage between 0.417V@100uA~0.49V@100uA (45℃~50℃), it triggers medium-high temperature protection with full voltage CV-50mV;

When IP4048 detects that the NTC pin voltage drops to less than 0.417V@100uA (above 50℃), it triggers high temperature protection and stops charging.

If NTC function is not required, connect the NTC pin to ground with a 10K resistor.

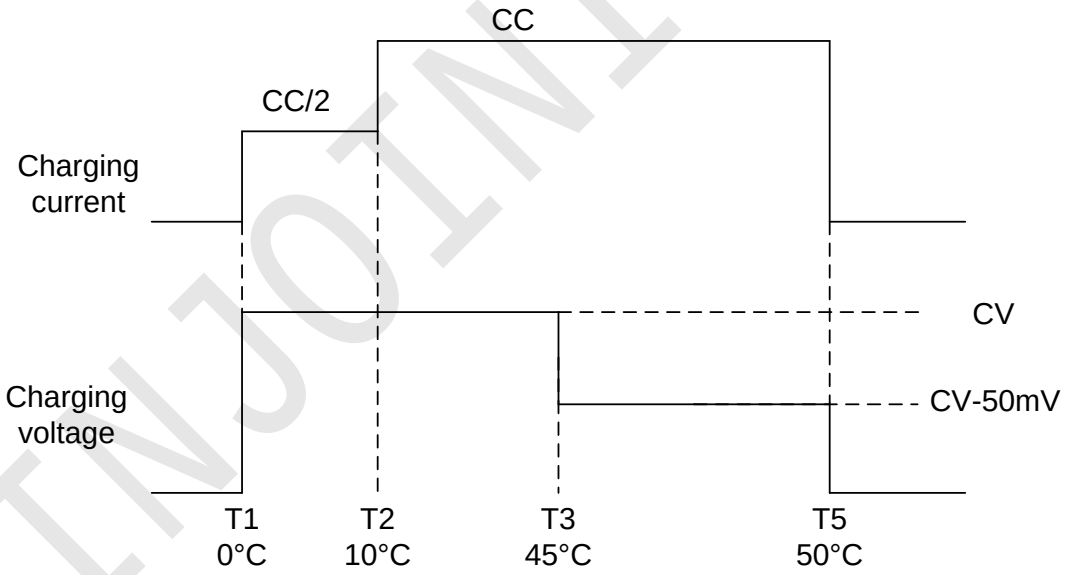


Figure 7 Schematic diagram of 5-segment battery temperature charge protection (JEITA compliant)

12.5 Charging LED indication

Standard product light display for: charging process LED on, charging full LED off, abnormal state (over-temperature protection, NTC protection) LED flashes (0.5S on, 0.5S off).

12.6 Battery reverse protection

IP4048 supports reverse battery protection, which can effectively prevent the chip from being damaged when the battery is reversed.

When VIN=0V, the maximum negative withstand voltage at the BAT terminal is -6V.

When VIN=5V, the maximum negative withstand voltage of BAT is -5V.

13 Typical Application Schematic

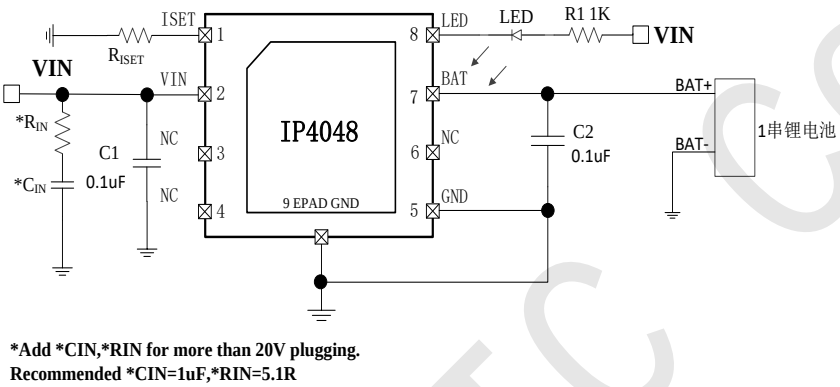
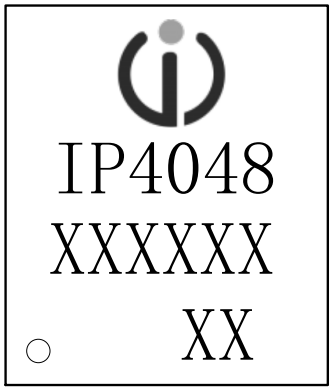


Figure 8 Typical Application Schematic

14 BOM

No.	Part Name	Type &Specification	Units	Quantity	Location	Note
1	IC	IP4048	PCS	1	U1	
2	SMD capacitors	0603 0.1uF 25V 10%	PCS	2	C_1、C_2	
3	SMD resistors	0603 1K 5%	PCS	1	R1	
4	SMD resistors	0603	PCS	1	R_{ISET}	
5	LED	0603	PCS	1	LED	
6	SMD capacitors	0603 1uF 50V 10%	PCS	1	*C_{IN}	Add when plugging or unplugging above 20V
7	SMD resistors	0603 5.1R 5%	PCS	1	*R_{IN}	

15 Silkscreen

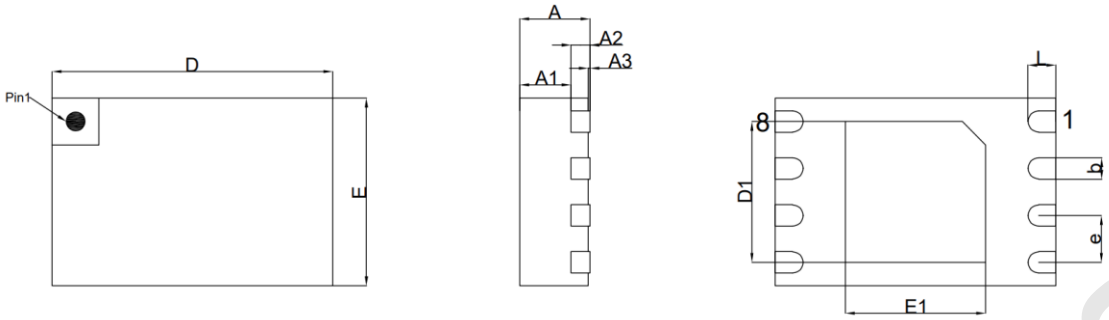


Instruction:

1、 --INJOINIC logo
2、IP4048 -Product name
3、XXXXXX -Product number
4、XX --Product number
5、○ --Pin1 Position

Figure 9 IP4048 Silkscreen

16 Package



	POD	DFNWB2×3-8L-NA(P0.5T0.75)		
		Size unit: mm		
	Symbol	Minimum	Normal	Maximum
Total Thickness	A	0.70	0.75	0.80
Molding Thickness	A1	-	0.55	-
LF Thickness	A2	-	0.203	-
Stand Off	A3	0.00	-	0.05
Body Size	D	2.90	3.00	3.10
	E	1.90	2.00	2.10
Exposed Pad Size	D1	1.40	1.50	1.60
	E1	1.40	1.50	1.60
Lead Width	b	0.18	0.23	0.28
Lead Length	L	0.25	0.30	0.35
Lead Pitch	e	0.50 BSC		

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