Support PD3.0 and other fast charge input protocols, support 2~5 series batteries
Power management chip with integrated lift drive and maximum charging power of 30W

1 Features

- **Charging specifications**
  - ✧ Integrated BUCK-BOOST, power NMOS diver
  - ✧ Maximum charging power 30W
  - ✧ Adaptive charging current adjustment
  - ✧ External Resistance Number of batteries in series: 2/3/4/5
  - ✧ External resistor can set maximum charging power, maximum support 30W
  - ✧ The input charging voltage ranges from 5 to 20V
  - ✧ Support battery types Ternary lithium battery (4.20V) and lithium iron phosphate battery (3.65V)
  - ✧ Support 0V battery charging
- **Quick charge specifications**
  - ✧ Integrated PD3.0 UFP protocol
  - ✧ Integrated DP&DM input fast charge protocol
- **Power display**
  - ✧ 2/1LED Power indicator
  - ✧ IP2363_I2C Customized models support the I2C function
  - ✧ Standby Power Loss 5μA
  - ✧ EN waking function
- **Multiple protection, high reliability**
  - ✧ Input over-voltage and under-voltage protection
  - ✧ Battery overcharge, over-current protection
  - ✧ IC over temperature protection
  - ✧ Rechargeable battery temperature NTC protection
  - ✧ ESD 4KV, input（CC1/CC2 pin）Withstand voltage 30V
- **Package：5mm × 5mm 0.5pitch QFN32**

2 Application Products

2 to 5 battery devices such as high-power speakers and power tools

3 Overview

IP2363 is a lithium battery charge management chip that integrates PD3.0 and DP&DM input fast charge protocol and synchronous lift converter, with charging power up to 30W;

IP2363 supports 2/3/4/5 series cells and the number of series cells can be selected by external resistance Settings.

IP2363 Built-in IC temperature, battery NTC temperature and input voltage control detection loop, can be identified according to the charger power, intelligent regulation of charging current.

IP2363 enters low power mode after disconnecting the charger， After entering low power mode, the standby current is reduced to 5μA. After entering the low power mode, the charger can be plugged in to wake up the charging automatically.

IP2363 built-in 14bit ADC, can accurately measure input voltage and current, battery voltage and current, etc. The charging and discharging voltage and charging current of IP2363 can be obtained through I2C.

The IP2363 supports two power indicators, which can display the power and charging and discharging status.

Content

4 Record

Note: The page numbers of previous versions may be different from those of the current version.

Change page numbers for version V1.01 to V1.02 (August 2024)	Page
● Fixed pin 31 DPC, pin 33 GND in pin diagram	5
● Added 0V battery charging description	11
Change page numbers for version V1.00 to V1.01 (May 2023)	**Page**
● Modify the description of the mos of the H-bridge in the BOM	18
First release V1.00 (April 2023)	

5 Simplified application

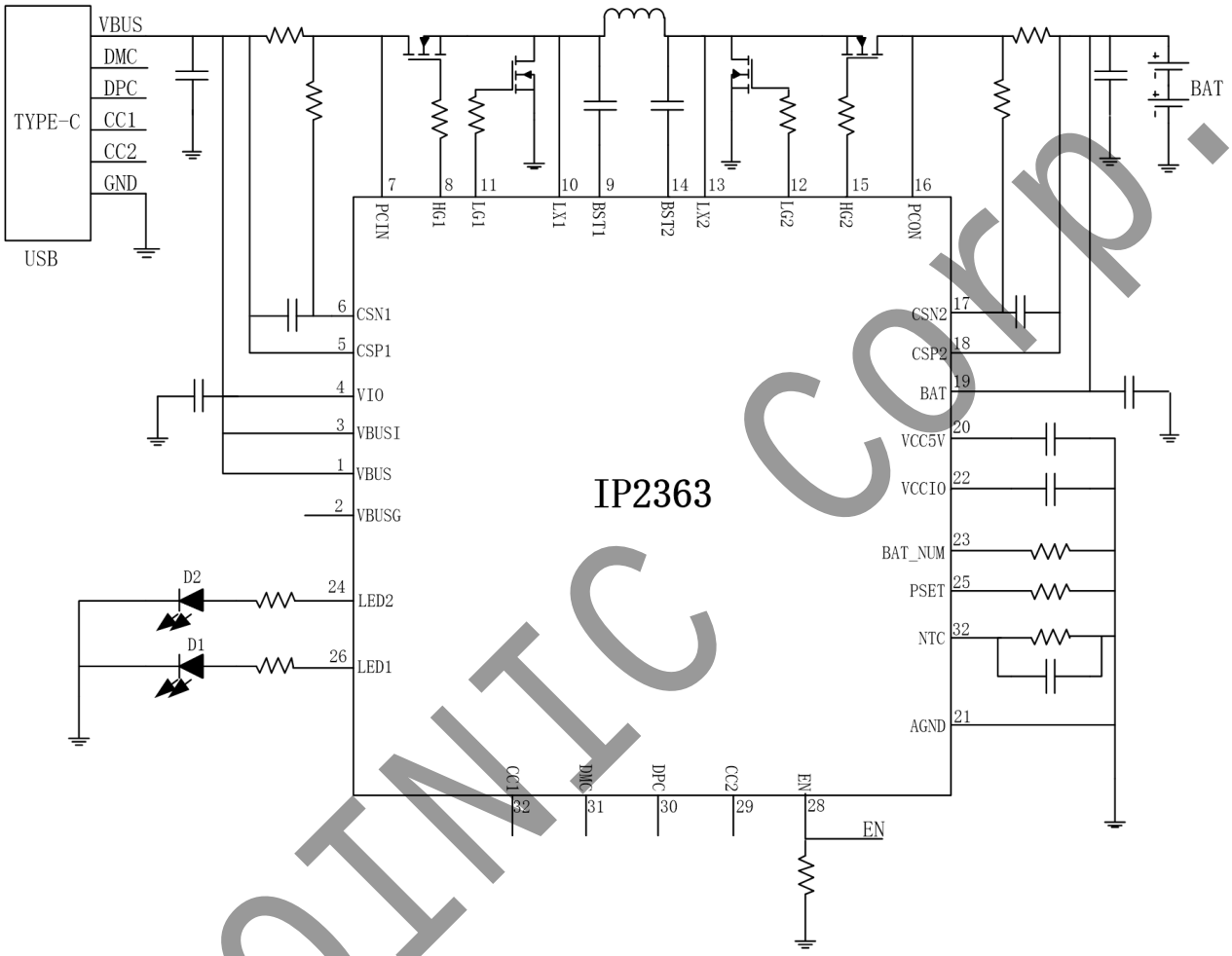


Figure 1 IP2363 Simplified application

6 Pin Description

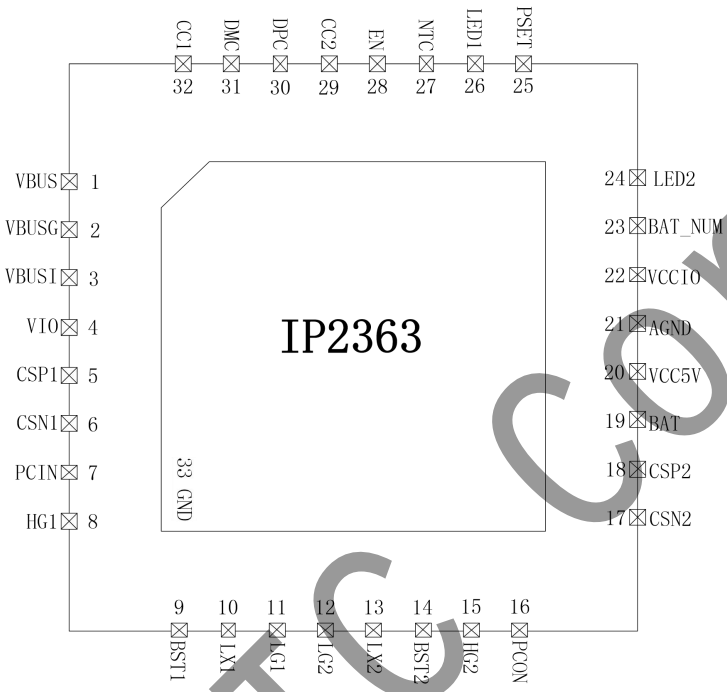


Figure 2 IP2363 pin diagram

6.1 Pin description

Pin Num	Pin Name	PIN description
1	VBUS	VBUS input detection pin
2	VBUSG	VBUS input path NMOS control pin
3	VBUSI	VBUS input path current detection pin
4	VIO	Power input pin
5	CSP1	Input current sampling positive terminal
6	CSN1	Input current sampling negative terminal
7	PCIN	Input peak current sampling pin
8	HG1	The upper tube control pin at the input end of the H-bridge power tube
9	BST1	Bootstrap voltage pin of H-bridge power tube input terminal
10	LX1	Input terminal inductance connection pin
11	LG1	H-bridge power tube input end lower tube control pin
12	LG2	H-bridge power tube output battery end lower tube control pin

13	LX2	Battery terminal inductance connection pin
14	BST2	Bootstrap voltage pin of H-bridge power tube battery terminal
15	HG2	The upper tube control pin of the battery end of the H-bridge power tube
16	PCON	Battery peak current sampling pin
17	CSN2	Average battery current sampling negative terminal
18	CSP2	Battery terminal current sampling positive terminal
19	BAT	Battery side power supply pin
20	VCC5V	System 5V power supply, to supply power to the internal analog circuit of the IC
21	AGND	Analog ground
22	VCCIO	System 3.3V power supply, to supply power to the internal digital circuit of the IC
23	BAT_NUM	BAT_NUM Specifies the number of batteries in series and connects the resistor to the ground
24	LED2	LED2（The I2C model serves as the I2C_SCL）
25	PSET	PSET set the maximum charging power of the system (I2C model as I2C_SDA)
26	LED1	LED1（The I2C model serves as the I2C_INLT）
27	NTC	NTC set charging protection temperature, connected with NTC resistor
28	EN	EN pin, connect 10K resistor and pull down to ground EN greater than 1.2V lasts for 200ms and can be woken from low power mode If the EN is greater than 1.2V for more than 10s, the system resets
29	CC2	USB C port detection and fast charge communication pin CC2
30	DPC	USB C port fast charge and intelligent recognition of DP
31	DMC	USB C port fast charge and intelligent identification DM
32	CC1	USB C port detection and fast charge communication pin CC1
33	GND	System ground and heat dissipation ground, need to keep good contact with GND

7 Internal block diagram of the chip

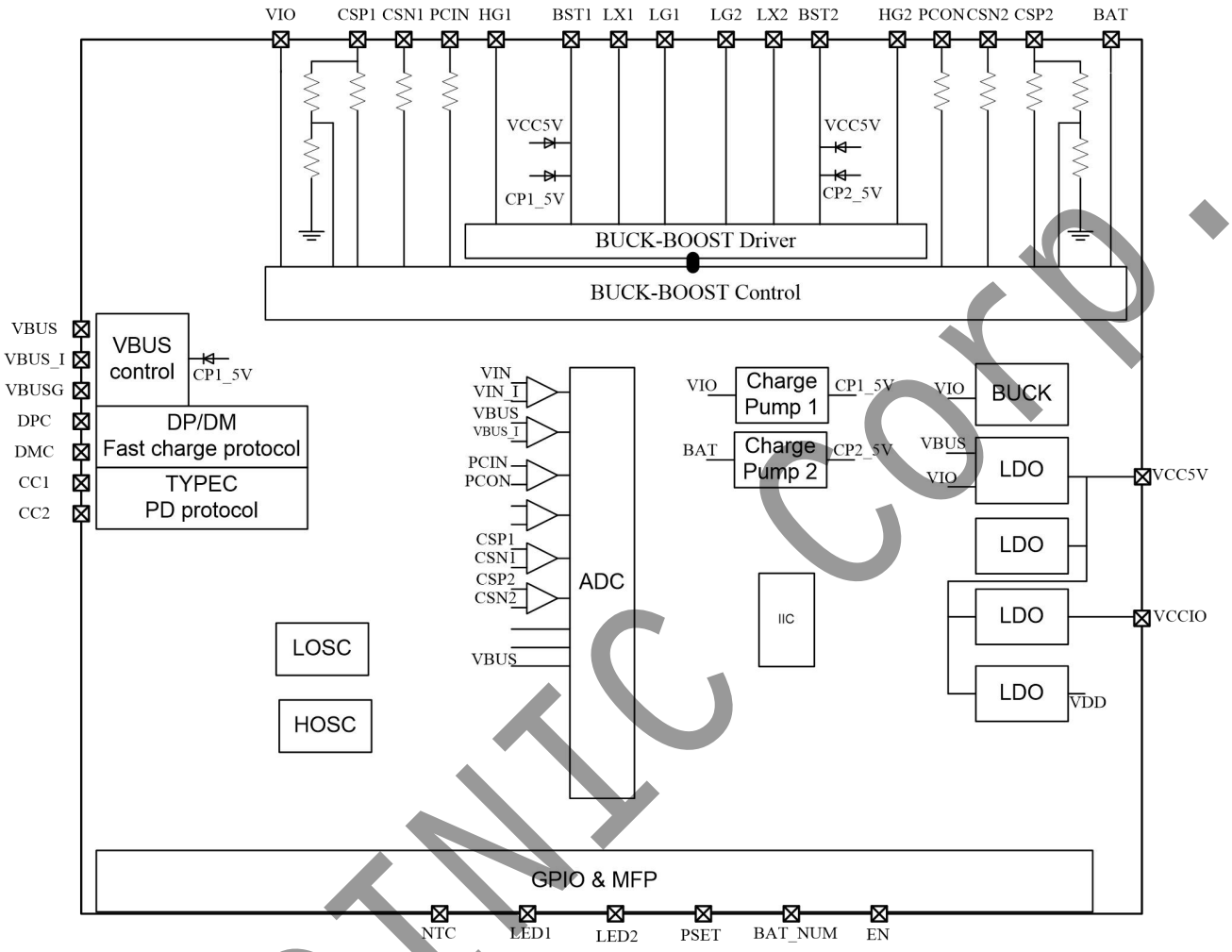


Figure 3 Internal block diagram of the chip

8 Limit parameters

Parameter	Symbol	Value	Unit
BAT voltage range	V_{BAT}	-0.3 ~ 35	**V**
VBUS voltage range	V_{VBUS}	-0.3 ~ 30	**V**
BST1/HG1-LX1 voltage range	$V_{BST1/HG1-LX1}$	-0.3 ~ 6	**V**
BST2/HG2-LX2 voltage range	$V_{BST2/HG2-LX2}$	-0.3 ~ 6	**V**
VIO voltage range	V_{VIO}	-0.3 ~ 30	**V**
LX1/BST1/HG1/LX2/BST2/HG2 voltage range	$V_{LX1/BST1/HG1}$ $V_{LX2/BST2/HG2}$	-0.3 ~ 50	**V**
CSP2/CSN2/PCIN voltage range	$V_{CSP2/CSN2/PCIN}$	-0.3 ~ 35	**V**
CSP1/CSN1/PCON voltage range	$V_{CSP1/CSN1/PCON}$	-0.3 ~ 30	**V**
CC1/CC2 voltage range	$V_{CC1/CC2}$	-0.3 ~ 30	**V**
DMC/DPC voltage range	$V_{DMC/DPC}$	-0.3 ~ 22	**V**
LED/PSET/NTC/BAT_NUM voltage range	$V_{LED/PSET/NTC/BAT\_NUM}$	-0.3 ~ 8	V
Junction temperature range	T_J	-40 ~ 125	℃
Storage temperature range	Tstg	-60 ~ 150	℃
Thermal resistance (junction temperature to environment)	θ_{JA}	45	**℃/W**
Human Body Model (HBM)	ESD	4	**KV**

*Stresses higher than the values listed in the Absolute Maximum Ratings section may cause permanent damage to the device. Excessive exposure under any absolute maximum rating conditions may affect the reliability and service life of the device.

9 Recommended working conditions

Parameter	Symbol	Min	Typical	Max	unit
Input voltage	VBUS	4.5		25	V
battery voltage	VBAT			32	V
Working temperature	T_A	-40		85	℃

*Beyond these operating conditions, device operating characteristics cannot be guaranteed.

10 Electrical characteristics

Unless otherwise specified, TA=25℃, L=4.7uH

Parameter	Symbol	Test Conditions		Min	Typical	Max	Unit
Charging system							
Input voltage	V_{BUS}			4.5	5/9/12/15/20	25	V
Input over-voltage	V_{BUS}	Rising voltage				25	V
Peak current	I_{L_PK}	Inductance peak current limit				6	A
Trickle charge current	I_{TRKL}	V_{VBUS}=5V, V_{BAT}<2.5V		30	50	70	mA
		V_{VBUS}=5V, 2.5V<=V_{BAT}<V_{TRKL}		100	200	300	mA
Trickle cut-off voltage	V_{TRKL}	The number of batteries is N, V_{TRGT} is not 3.65V		N*2.9	N*3	N*3.1	V
		The number of batteries is N, V_{TRGT} is 3.65V		N*2.65	N*2.75	N*2.85	V
Charge constant voltage	V_{CV}	The number of batteries is N, V_{TRGT} is not 3.65V		N*4.15	N*4.20	N*4.25	V
		The number of batteries is N, V_{TRGT} is 3.65V		N*3.6	N*3.65	N*3.7	V
Charge current	I_{CHRG}	VBUS=5V，input current		2.7	3.0	3.3	A
		VBUS=9V, PD fast charge, Input current	PMAX=20W	2.7	2.22	3.3	A
			PMAX=30W	2.8	3.0	3.2	A
		VBUS=9V, Not PD fast charge, Input current	PMAX≥20W	1.8	2.0	2.2	A
		VBUS=12V, PD fast charge, Input current	PMAX=20W	1.5	1.66	1.8	A
			PMAX=30W	2.3	2.5	2.7	A
		VBUS=12V, Not PD fast charge, Input current	PMAX≥20W	1.3	1.5	1.7	A
		VBUS=15V, Input current	PMAX=20W	1.1	1.33	1.5	A
			PMAX=30W	1.8	2.0	2.2	
		VBUS=20V, Input current	PMAX=20W	0.8	1.0	1.2	A
			PMAX=30W	1.25	1.5	1.75	A
Stop charging current	I_{STOP}				100		mA

Recharge threshold	V_{RCH}	The number of battery cells is N		V_{TRGT} – N*0.1		V
Charging timeout	T_{END}			48		Hour
Control system						
Frequency	fs	Discharge switching frequency		400		kHz
VCC5V output voltage	V_{CC5V}		4.75	5	5.25	V
VCC5V output current					30	mA
VCCIO output voltage	V_{CCIO}		3.15	3.3	3.45	V
VCCIO output current	I_{CCIO}				30	mA
standby current	I_{STB}	VBAT=21V, the average current after the VBUS is removed for 1 minute		5	10	μA
LED Pin drive current	I_{L1} I_{L2}	Voltage drop 10%	5	7	10	mA
Thermal shutdown temperature	T_{OTP}	Rising temperature	110	125	140	℃
Thermal shutdown temperature hysteresis	ΔT_{OTP}			40		℃

11 Function description

11.1 Charging function

The IP2363 has a constant-current, constant-voltage lithium battery charge management system that supports a synchronous voltage switch structure.

IP2363 adopts switching charging technology with switching frequency of 400kHz.

IP2363 resistance can be set in different cell types, full of charging voltage and power, can support 2/3/4/5 / battery set; The maximum input charging power can reach 20V/1.5A(30W), the highest charging efficiency to 95%;

IP2363 supports the trickle-constant-current-constant-voltage charging process:

When the battery voltage 0≤VBAT≤ 2.5V, small current trickle charging, battery charging current about 50mA;

When the battery voltage is 2.5V <VBAT≤ VTRKL, trickle charging, battery charging current is about 200mA;

When the battery voltage VTRKL<VBAT< VCV, for constant current charging, according to the set constant current charging current to charge the battery;

When the battery voltage VBAT = VCV, the battery voltage rises to close to full voltage, the charging current will slowly decline and enter the constant voltage charging.

After entering constant voltage charging, when the battery charging current is less than ISTOP and the battery voltage is close to constant voltage, stop charging and enter full state.

After the battery is fully charged, it continues to check the battery voltage. When the battery voltage is lower than VBAT <VRCH, it starts charging again；

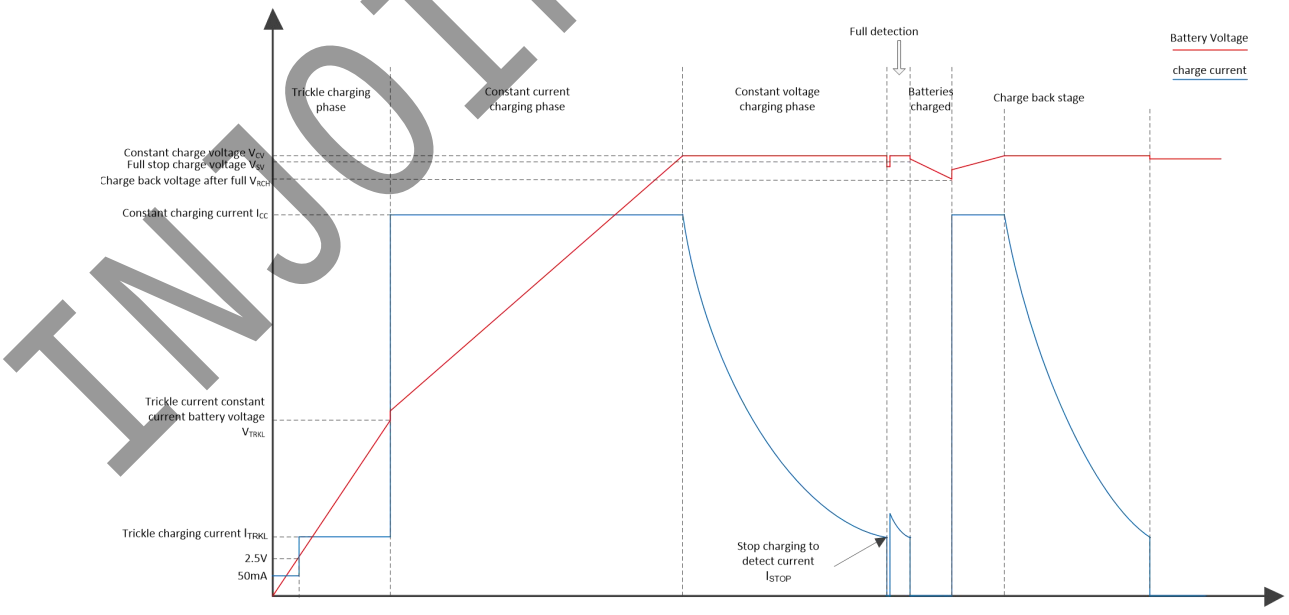


Figure 4 Battery charging process diagram

IP2363 integration has an PD3.0 and DP&DM input quick charge agreement, can through the Type - C mouth of DPC/DMC/CC1 / CC2 to fast was electrical application fast charging pressure, automatically adjust the charging current size, to adapt to different load capacity of the charger.

When charging with a charger without a fast charge or a DC power supply, the IP2363 sets the charging current according to the input voltage:

Input voltage	Maximum input current for constant current charging
4.5<VBUS≤6.5V	3A
6.5<VBUS≤9.5V	2A
9.5<VBUS≤13.5V	1.5A
13.5<VBUS≤16.5V	2A
16.5<VBUS≤24V	1.5A

Note: When the actual charging power is greater than the set maximum input power limit, the charging current will also be reduced;

The IP2363 supports DP&DM input fast charge protocol， IP2363 will apply for the highest input voltage, constant current charging current is set according to the above input voltage gear;

IP2363 supports PD3.0 input protocol, and when charging with PD fast charge adapter,IP2363 will read the PD information packet sent by the adapter, and then apply for charging voltage and set charging current according to the received PD information packet. When the power of the received PD packet is less than the set power required for charging, the charging current will be actively reduced so that the maximum power of the input terminal is less than or equal to the PD broadcast power given by the adapter;

11.2 Protection function

IP2363 has perfect protection function, integrated input undervoltage, overvoltage protection, NTC temperature protection, IC overtemperature protection and other functions to ensure the stable and reliable work of the system.

The IP2363 has an input voltage regulating loop. When the input voltage is detected to be close to the input undervoltage threshold, it will automatically adjust and reduce the charging current to ensure that the input voltage is stable near the input undervoltage threshold and ensure that the adapter will not be pulled.

IP2363 integrated input overvoltage protection function, when the input voltage is greater than the input overvoltage threshold, it will stop charging;

IP2363 integrates NTC function with NTC resistor, can detect the battery temperature, when the battery temperature is detected too high or too low, can stop charging;

IP2363 integrated charge timeout protection function, if the charge lasts for more than 48H and the battery is not detected, it will forcibly stop charging;

IP2363 integrated overtemperature protection function, when the internal temperature of the chip is detected to exceed 125 degrees, it will forcibly stop charging;

11.3 Input and output maximum power setting

IP2363 determines the maximum power of input and output of the system by determining the resistance value of the PSET pin connection.

RPSET	Corresponding to the set maximum power PMAX	Corresponding to the set battery charging voltage
13k	30W	4.2V
9.1k	30W	3.65V
6.2k	20W	4.2V
3.6k	20W	3.65V

11.4 Set the number of batteries in series

IP2363 determines the number of batteries in series by determining the resistance value of BAT_NUM pin connection.

RBAT_NUM	Corresponding to the set number of batteries in series
13k	5bunch
9.1k	4bunch
6.2k	3bunch
3.6k	2bunch

11.5 NTC function

IP2363 integrates the NTC function to detect the battery temperature. When IP2363 works, it generates a constant current source on the NTC pin and generates voltage with the external pull-down NTC thermistor. The chip determines the current battery temperature by detecting the voltage of the NTC pin internally.

* A 100nF capacitor in parallel with GND at the NTC pin should be placed close to the chip pin.

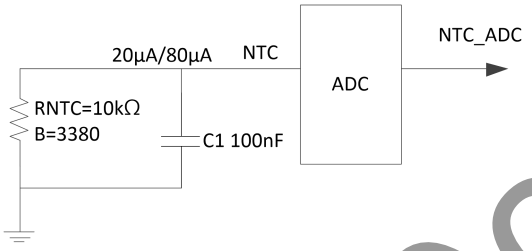


Figure 5 Comparison of battery NTC

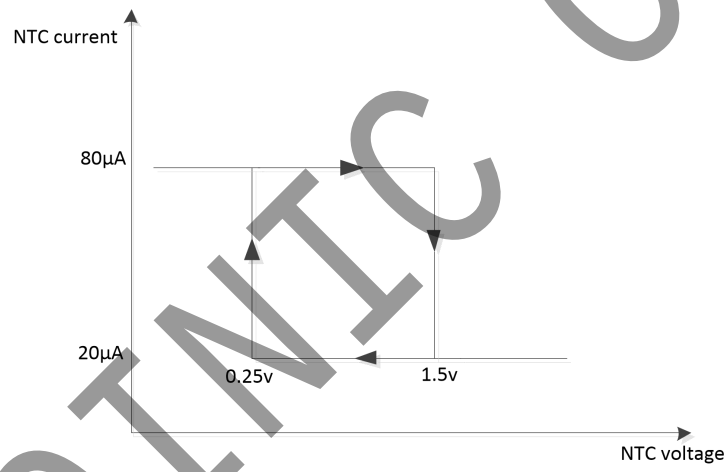


Figure 6 NTC voltage and outgoing current relationship

In order to accurately distinguish the temperature of the battery NTC, IP2363 adopts the current switching type NTC detection module. The chip detects the current output by the NTC pin and the voltage generated by the external pull-down NTC thermistor to determine the current battery temperature.

When the output current of the NTC pin is 80μA and the voltage of the NTC pin is detected to be higher than 1.5V, the output current of the NTC pin is adjusted to output 20μA.

When the output current of the NTC pin is 20μA and the voltage of the NTC pin is detected to be lower than 0.25V, the output current of the NTC pin is adjusted to output 80μA.

In the charging state:

When the output current of the NTC is 80μA and the voltage of the detecting NTC pin is lower than 0.39V, the battery temperature is higher than 45 ° C and the charging function stops.

When the output current of NTC is 20μA and the voltage of the detecting NTC pin is higher than 0.55V, the battery temperature is lower than 0 ° C and the charging function stops.

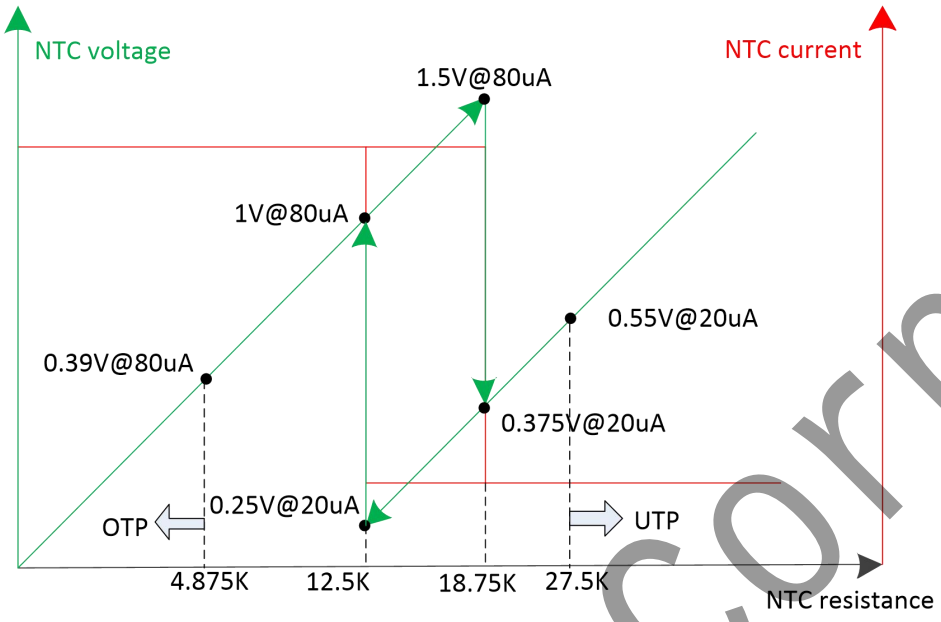


Figure 7 Relationship between NTC voltage and NTC resistance

If the NTC function is not required in the solution, connect the NTC pin to the ground with a 10 kω resistor. Do not float the NTC pin or ground it directly.

11.6 Lamp display function

IP2363 Support 2, and 1 battery indicator, the connection method is as follows.

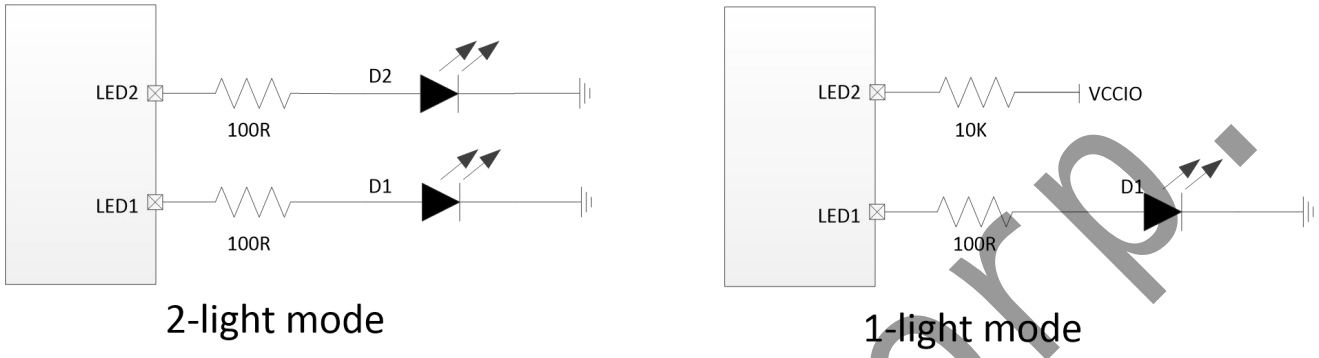


Figure 8 2, 1LED connection mode

The display mode of 2 lights is:

Charging state	D1	D2
Charging	on	Off
full	off	on
Input overvoltage, NTC overtemperature, charge timeout, IC overtemperature	Both D1 and D2 blink simultaneously (on for 250ms and off for 250ms)	

The display mode of 1 lights is:

Charging state	D1
Charging	Blinking on D1 (1s on and 1s off)
full	D1 Steady on
Input overvoltage, NTC overtemperature, charge timeout, IC overtemperature	D1 Fast blinking (on for 250ms and off for 250ms)

Note: In 1 light mode, LED2 cannot be suspended, you need to pull LED2 up to VCCIO to automatically identify the success.

11.7 EN key function

IP2363 will enter low power mode when the charger is pulled out and the VBUS voltage is less than 3V, and the BAT standby power consumption is 5uA;

In low power mode, I2C and internal ADC can not work properly, so the model IP2363_I2C, after the VBUS power, will delay 10s to enter low power mode;

If you do not want the IP2363_I2C to enter low power mode, you can turn off the low power mode by

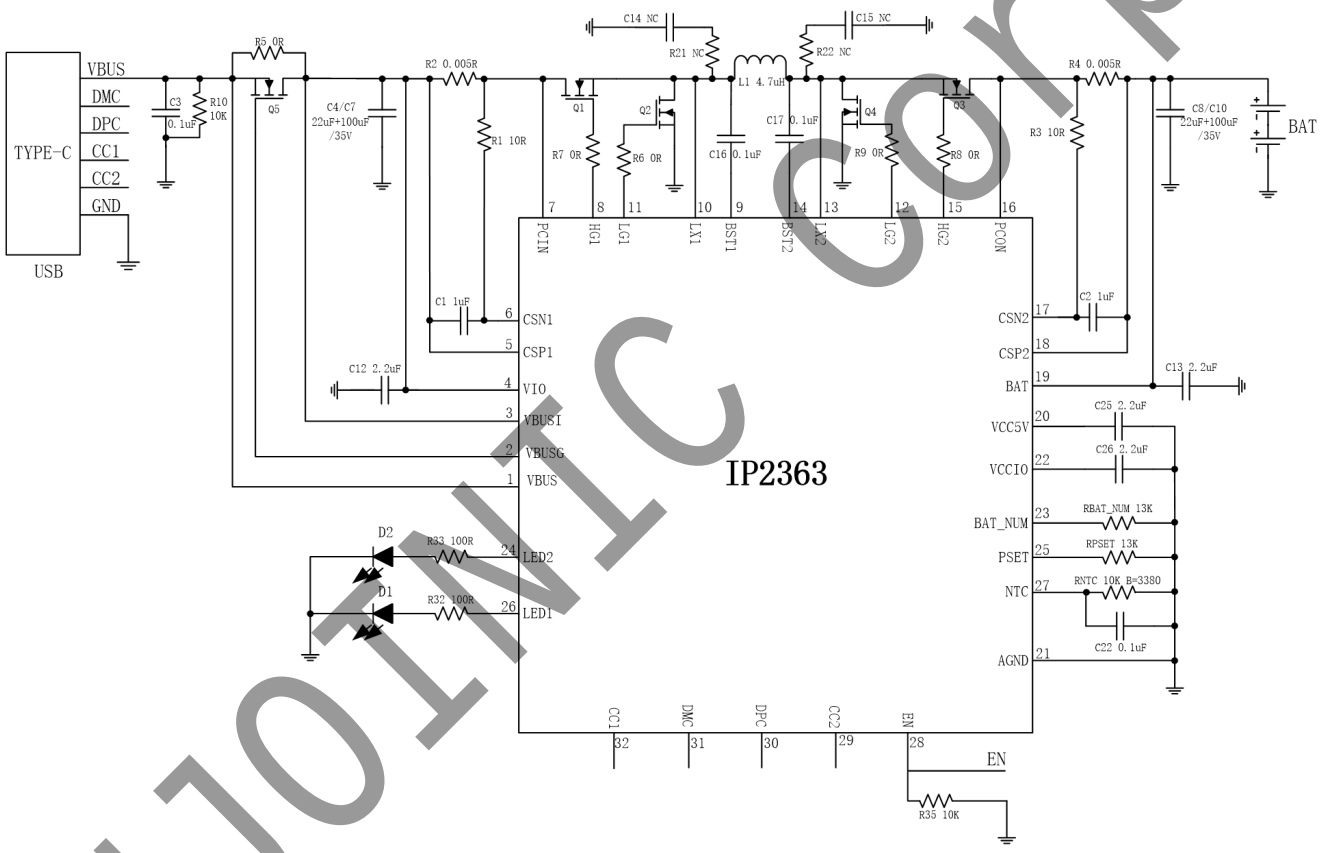
writing the register;

If IP2363_I2C has entered low power mode, it can be woken up by outputting 200ms high level (greater than 1.2V) pulse to EN pin. After woken up, it requires a delay of 500ms before operating I2C.

EN pin has a high level (>1.2V) for 10s, the chip will reset;

EN cannot be suspended, it must be connected to the ground by a 10K resistor;

12 Application schematic diagram



RPSET	PMAX	Set the battery charging voltagel
13K	30W	4.2V
9.1K	30W	3.65V
6.2K	20W	4.2V
3.6K	20W	3.65V

RBAT_NUM	Set the number of batteries inseries
13K	5bunch
9.1K	4bunch
6.2K	3bunch
3.6K	2bunch

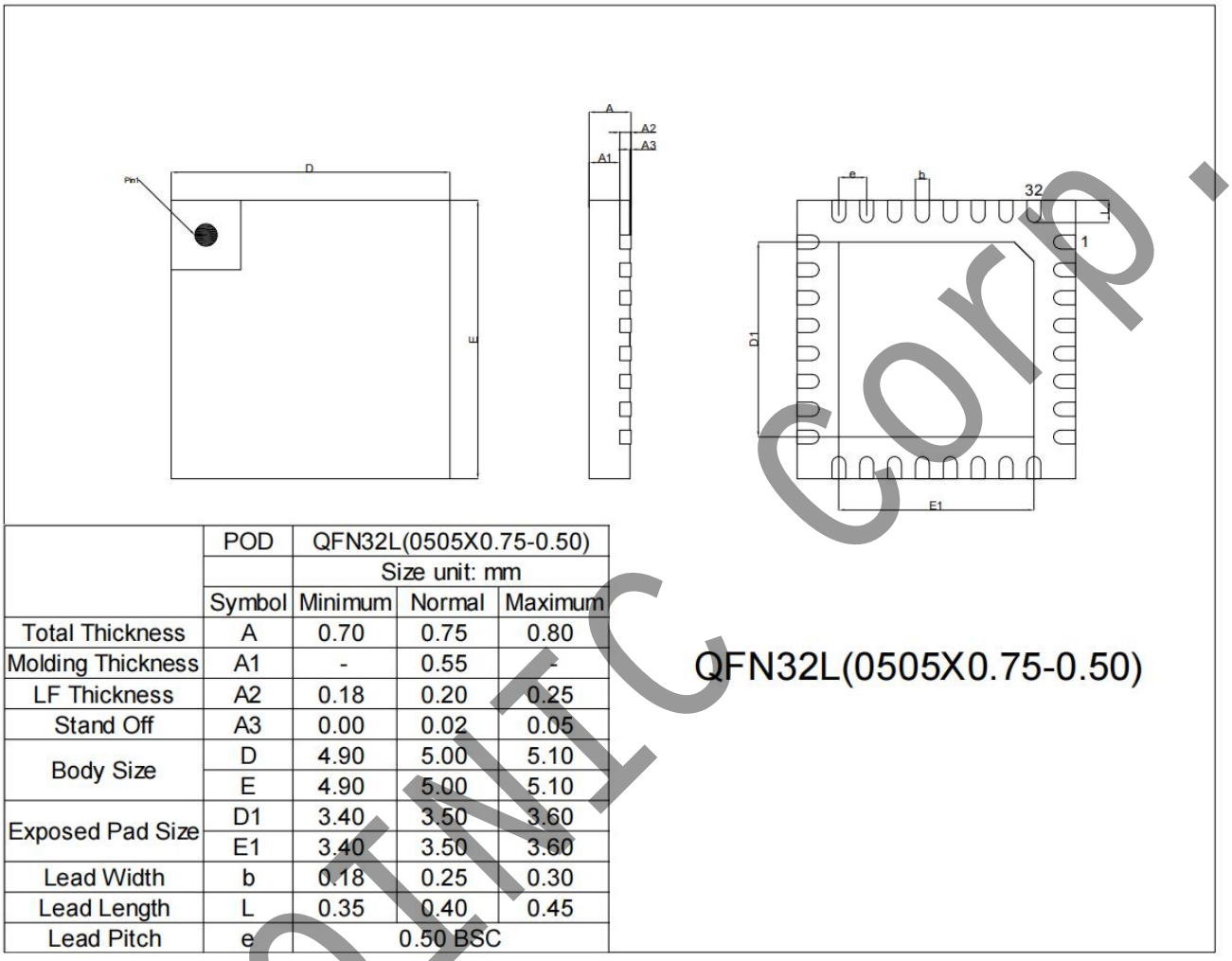
Figure 9 Application principle diagram of standard models

13 BOM

Num	Component name	Model & Specification	Location	Dosage	Remark
1	Patch IC	QFN32 IP2363	U1	1	
2	SMD capacitors	0603 1μF 10% 35V	C1,C2	2	
3	SMD capacitors	0603 0.1uF 10% 50V	C3,C16,C17,C22	4	
4	SMD capacitors	0805 22μF 10%	C4,C10	2	
5	SMD capacitors	0603 2.2μF 10% 35V	C12,C13,C25,C26	4	
6	Solid capacitor	100μF 35V 10%	C7,C8	2	
7	SMD resistor	1206 0R	R5	1	NC, paste Q5 when certified
8	SMD resistor	1206 0.005R 1%	R2,R4	2	The sampling resistance requires a metal film resistance with high precision and low temperature
9	SMD resistor	0603 100R 5%	R32,R33	2	
10	SMD resistor	0603 10R 1%	R1,R3	2	
11	SMD resistor	0603 10K	R10,R35	2	
12	Thermistance	0603 10K B=3380	R12	1	
13	SMD resistor	0603 0R	R6,R7,R8,R9	4	
14	SMD resistor	0603 13K	RBAT_NUM,RPSET	2	Configure as required in the table
15	Lifting voltage inductance	4.7μH 8A R_{DC}<0.01R	L1	1	
16	USB C	USB C	USB	1	
17	SMD MOS	NMOS	Q1,Q2,Q3,Q4	2	H-bridge NMOS，$R_{DS(ON)}$≤28mR，V_{DS} ≥ 30V，I_D ≥ 8A
18	SMD LED	0603 LED	D1,D2	2	2 Light mode
19	SMD MOS	RU3030M2	Q5	1	NC, pasted upon certification

20	SMD capacitors	0603 3.3nF 10% 50V	C14,C15	2	NC, pasted upon certification
21	SMD resistor	0603 2R	R21,R22	2	NC, pasted upon certification

14 Package



	POD	QFN32L(0505X0.75-0.50)		
		Size unit: mm		
	Symbol	Minimum	Normal	Maximum
Total Thickness	A	0.70	0.75	0.80
Molding Thickness	A1	-	0.55	-
LF Thickness	A2	0.18	0.20	0.25
Stand Off	A3	0.00	0.02	0.05
Body Size	D	4.90	5.00	5.10
	E	4.90	5.00	5.10
Exposed Pad Size	D1	3.40	3.50	3.60
	E1	3.40	3.50	3.60
Lead Width	b	0.18	0.25	0.30
Lead Length	L	0.35	0.40	0.45
Lead Pitch	e	0.50 BSC		

Figure 10 Package

15 Silkscreen

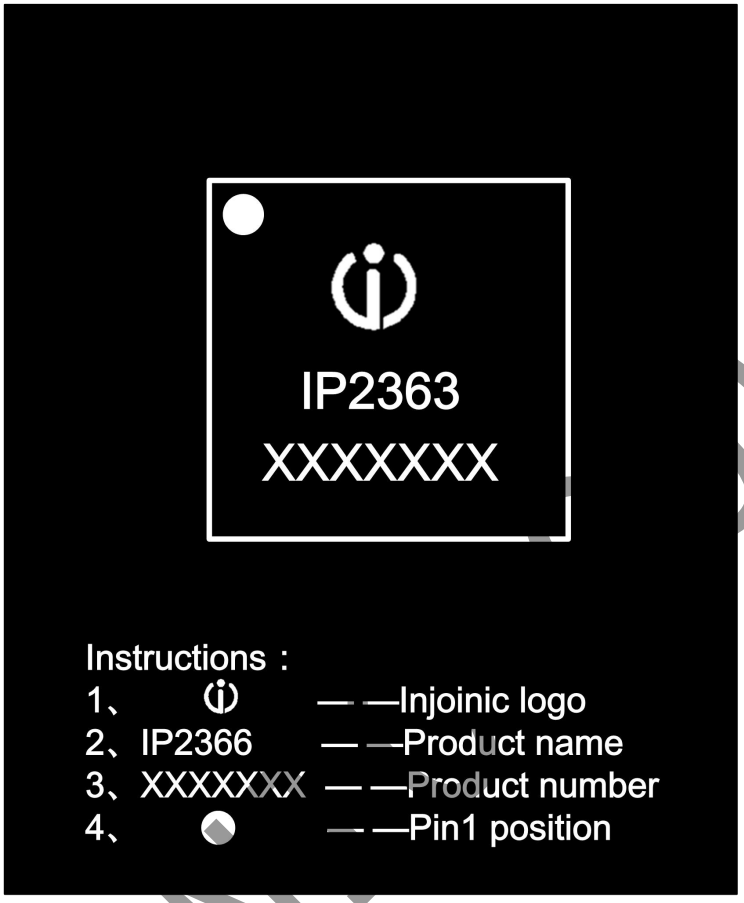


Figure 11 Silkscreen

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