Support PD3.0 and other fast charge input protocol, support 2~6 series batteries
Integrated buck-boost power Nmos, Charging management chip with a maximum charging power of 45W

1 Features

- **Charging specifications**
  - ✧ Integrated BUCK-BOOST, power NMOS
  - ✧ Maximum charging power 45W
  - ✧ Adaptive charging current adjustment
  - ✧ External resistor can set full voltage,The full voltage of a single lithium battery can be set in 3.65V/4.1V/4.2V/4.35V/4.4V
  - ✧ External resistance selection 2/3/4/5/6 series battery cell charging
  - ✧ External resistor can set maximum charging power, maximum support 45W
  - ✧ supports 0V battery charging
- **Supports two USB ports**
  - ✧ 1 USB-A port output
  - ✧ 1 USB-C port input and output
- **Quick charge specifications**
  - ✧ Integrated FCP input fast charge protocol
  - ✧ Integrated AFC input fast charge protocol
  - ✧ Integrated DRP Try. SRC agreement, quick charge agreement PD3.1 input and output
  - ✧ Integrated QC2.0/QC3.0/QC3.0+ output fast charge protocol
  - ✧ supports 0V battery charging
- **Power display**
  - ✧ 4/2/1LED Power indicator
  - ✧ Customization supports the I2C function
  - ✧ Standby Power Loss 100μA
  - ✧ EN waking function
- **Multiple protection, high reliability**
  - ✧ Input over-voltage and under-voltage protection
  - ✧ Output over-current and short-circuit protection
  - ✧ Battery overcharge, over-discharge, over-current protection
  - ✧ IC over temperature protection
  - ✧ Rechargeable battery temperature NTC protection
  - ✧ ESD 4KV, input（CC1/CC2 pin）Withstand voltage 30V
- **Package：QFNWB-7*7-60L 0.4pitch**

2 Application Products

2~6 series lithium battery/lithium iron phosphate battery charge and discharge

3 Overview

IP2369 is a lithium battery charging and discharging management chip integrating AFC/FCP/PD2.0/ PD3.0/PD3.1 input/output fast charging protocols and synchronous voltage converter, with charging and discharging power up to 45W.

IP2369 has high integration and rich functions, Integrated BUCK-BOOST boost power NMOS, only one inductor is needed to realize synchronous voltage reduction and boost function, and only few peripheral devices are needed in application, which effectively reduces the overall solution size and BOM cost.

IP2369 supports 2/3/4/5/6 series cells and the number of series cells can be selected by external resistance Settings. The IP2369 supports an external resistor with configurable battery type and a full voltage of 3.65V/4.1V/4.2V/ 4.35V/4.4V.

IP2369 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.

The standby power consumption of the IP2369 can be as low as 100uA.

IP2369 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 IP2369 can be obtained through I2C.

The IP2369 supports four power indicators, which can display the power and charging and discharging status.

Contents

4 Record

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● Improve the PDO of low power mode in the discharge function	17
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● 10uA Low Power Standby Changed the value to 100uA standby……	1
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First release V1.00 (February 2024)	

5 Simplified application

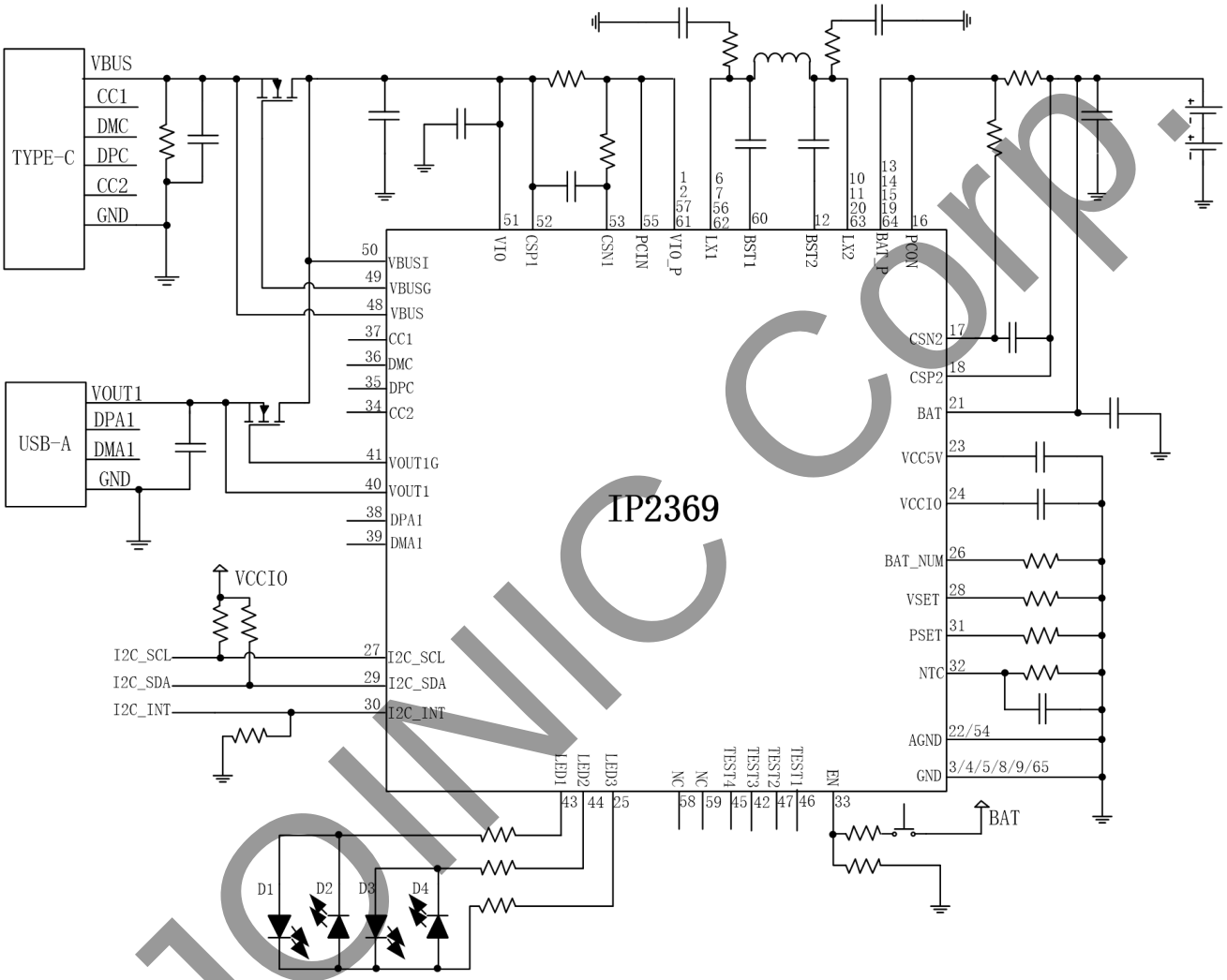


Figure 1 IP2369 Simplified application

6 Pin Description

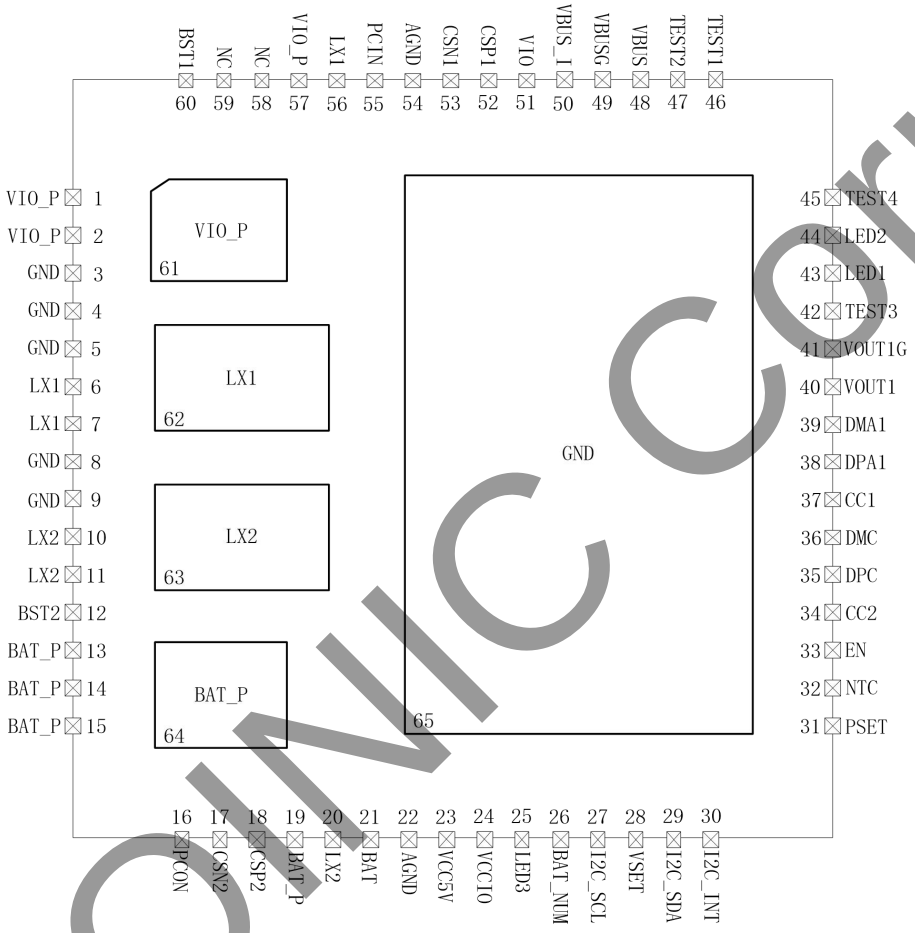


Figure 2 IP2369 pin diagram

6.1 Pin description

Pin Num	Pin Name	Definition
1	VIO_P	VIO terminal power pin
2	VIO_P	VIO terminal power pin
3	GND	GND of the power path
4	GND	GND of the power path
5	GND	GND of the power path
6	LX1	VIO terminal inductance connection pin
7	LX1	VIO terminal inductance connection pin
8	GND	GND of the power path
9	GND	GND of the power path
10	LX2	Battery terminal inductance connection pin
11	LX2	Battery terminal inductance connection pin
12	BST2	Bootstrap voltage pin of H-bridge power tube battery terminal
13	BAT_P	Battery terminal power pin
14	BAT_P	Battery terminal power pin
15	BAT_P	Battery terminal power pin
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_P	Battery terminal power pin
20	LX2	Battery terminal inductance connection pin
21	BAT	Battery side power supply pin
22	AGND	Analog ground
23	VCC5V	System 5V power supply, to supply power to the internal analog circuit of the IC
24	VCCIO	System 3.3V power supply, to supply power to the internal digital circuit of the IC
25	LED3	Lamp display pin LED3
26	BAT_NUM	BAT_NUM Set the number of batteries in series and connect the resistance to the ground
27	I2C_SCL	The I2C model serves as the I2C_SCL
28	VSET	VSET Set a single battery charging voltage, connect resistance to the ground
29	I2C_SDA	The I2C model serves as the I2C_SDA
30	I2C_INT	The I2C model serves as the I2C_INT
31	PSET	PSET Set the maximum charge and discharge power of the system and connect the resistance to the ground

32	NTC	NTC set protection temperature, connected with NTC resistor
33	EN	EN wake up pin, connected to the key to realize startup wake up and shutdown
34	CC2	USB C port detection and fast charge communication pin CC2
35	DPC	USB C port fast charge and intelligent recognition of DP
36	DMC	USB C port fast charge and intelligent identification DM
37	CC1	USB C port detection and fast charge communication pin CC1
38	DPA1	USB A port fast charge and intelligent recognition of DP
39	DMA1	USB C port fast charge and intelligent identification DM
40	VOUT1	Port A outputs the detection pin
41	VOUT1G	Port A output path NMOS control pin
42	TEST3	Test point,NC
43	LED1	Lamp display pin LED1
44	LED2	Lamp display pin LED2
45	TEST4	Test point,NC
46	TEST1	Test point,NC
47	TEST2	Test point,NC
48	VBUS	VBUS input detection pin
49	VBUSG	VBUS input path NMOS control pin
50	VBUS_I	VBUS input path current detection pin
51	VIO	Power input pin
52	CSP1	Input current sampling positive terminal
53	CSN1	Input current sampling negative terminal
54	AGND	Analog ground
55	PCIN	Input peak current sampling pin
56	LX1	VIO terminal inductance connection pin
57	VIO_P	VIO terminal power pin
58	NC	
59	NC	
60	BST1	Bootstrap voltage pin of H-bridge power tube input terminal
61	VIO_P	VIO terminal power pin
62	LX1	VIO terminal inductance connection pin
63	LX2	Battery terminal inductance connection pin
64	BAT_P	Battery terminal power pin
65	GND	GND of the power path

7 Internal block diagram of the chip

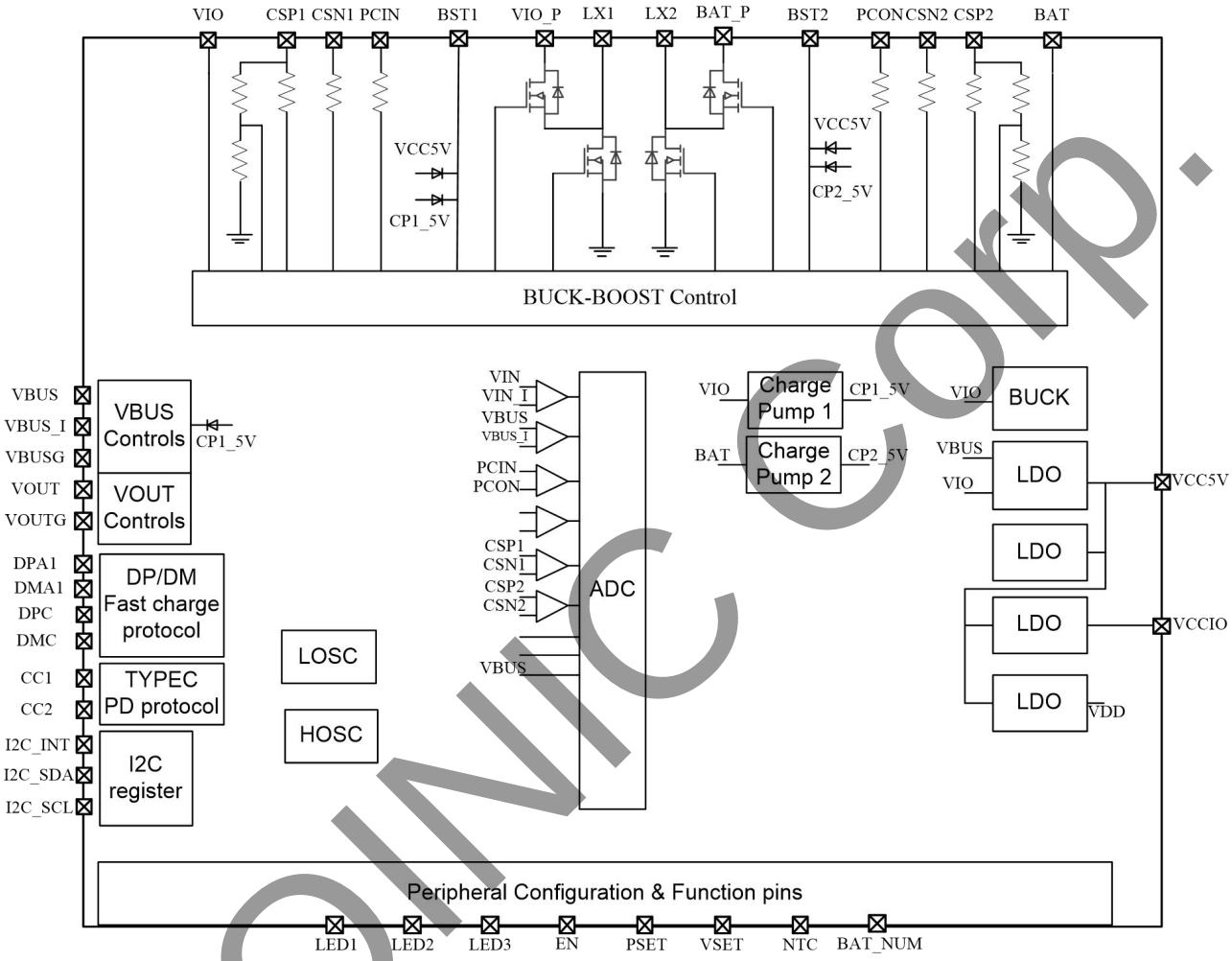


Figure 3 Internal block diagram of the chip

8 Limit parameters

Parameter	Symbol	Value	Unit
BAT voltage range	V_{BAT}	-0.3 ~ 32	**V**
VBUS voltage range	V_{VBUS}	-0.3 ~ 30	**V**
VIO voltage range	V_{VIO}	-0.3 ~ 30	**V**
LX1/BST1/LX2/BST2 voltage range	$V_{LX1/BST1/LX2/BST2}$	（-3V for 10ns）-0.3 ~ 40	**V**
CSP2/CSN2/PCIN voltage range	$V_{CSP2/CSN2/PCIN}$	-0.3 ~ 32	**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**
Other pins voltage range	$V_{LED/EN/TEST/PSET}$	-0.3 ~ 8	V
I2C Interface voltage range	$V_{I2C\_INT/SDA/SCL}$	-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/VOUT1	4.5		22	V
battery voltage	VBAT			30	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=10uH

Parameter	Symbol	Test Conditions		Min	Typical	Max	Unit
Charging system							
Input voltage	V_{BUS}			4.5	5/9/12/15/20	22	V
Input over-voltage	V_{BUS}	Rising voltage		21.5	22	22.5	V
Peak current	I_{L_PK}	Inductance peak current limit				12	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*2.7	N*2.75	N*2.85	V
Charge constant voltage	V_{CV}	The number of batteries is N, R_{VSET} = 27K		N*4.35	N*4.40	N*4.45	V
		The number of batteries is N, R_{VSET} = 18K		N*4.20	N*4.35	N*4.40	V
		The number of batteries is N, R_{VSET} = 13K		N*4.25	N*4.30	N*4.35	V
		The number of batteries is N, R_{VSET} = 9.1K		N*4.15	N*4.20	N*4.25	V
		The number of batteries is N, R_{VSET} = 6.2K		N*4.05	N*4.10	N*4.15	V
		The number of batteries is N, R_{VSET} = 3.6K		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	2.00	2.22	2.44	A
			PMAX>=27W	2.70	3.00	3.30	A
		VBUS=9V, Not PD fast charge, Input current	PMAX>=20W	1.80	2.00	2.20	A
		VBUS=12V, PD fast charge, Input current	PMAX=20W	1.50	1.67	1.84	A
			PMAX=27W	2.03	2.25	2.47	A
			PMAX=30W	2.25	2.50	2.75	A
			PMAX>=36W	2.70	3.00	3.30	A
		VBUS=12V, Not	PMAX>=20W	1.35	1.50	1.65	A

		PD fast charge, Input current					
		VBUS =15V, PD and not PD, input current	PMAX=20W	1.12	1.25	1.37	A
			PMAX=27W	1.53	1.70	1.87	A
			PMAX=30W	1.71	1.90	2.09	A
			PMAX=36W	2.07	2.30	2.53	A
			PMAX=45W	2.56	2.85	3.13	A
		VBUS =20V, PD and not PD, input current	PMAX=20W	0.85	0.95	1.04	A
			PMAX=27W	1.15	1.28	1.40	A
			PMAX=30W	1.28	1.43	1.57	A
			PMAX=36W	1.53	1.70	1.87	A
			PMAX=45W	1.92	2.14	2.35	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
Discharge system							
Battery working voltage	V_{BAT}	The number of battery cells is N		N*2.70		N*4.45	V
Switch working battery input current	I_{BAT}	VBAT=6*3.7V, VOUT=5.0V, fs=250kHz, Iout=0mA			12		mA
DC output voltage	QC2.0 V_{OUT}	V_{OUT}=5V@1A		4.75	5.00	5.25	V
		V_{OUT}=9V@1A		8.70	9	9.30	V
		V_{OUT}=12V@1A		11.60	12	12.40	V
	QC3.0/ QC3+ V_{OUT}	@1A		3.6		12	V
	QC3.0 Step				200		mV
	QC3+ Step				20		mV
Output voltage ripple	ΔV_{OUT}	VBAT=4*3.7V, VOUT=5.0V, fs=250KHz, Iout=1A			85		mV
		VBAT=4*3.7V, VOUT=9.0V ,			100		mV

		fs=250KHz, Iout=1A				
		VBAT=4*3.7V， VOUT=12V，fs=250KHz, Iout=1A		100		mV
		VBAT=4*3.7V， VOUT=15V，fs=250KHz, Iout=1A		100		mV
		VBAT=4*3.7V， VOUT=20V，fs=250KHz, Iout=1A		120		mV
		VBAT=4*3.7V, VOUT=5.0V, fs=250KHz, Iout=1A		200		mV
Maximum output power of the discharge system	Pmax	PD protocol			45	W
Discharge system efficiency	η_{out}	V_{BAT}=2*3.0V, V_{OUT}=20V, I_{OUT}=1.5A		92.0		%
		V_{BAT}=4*3.0V, V_{OUT}=20V, I_{OUT}=1.5A		95.0		%
		V_{BAT}=6*3.0V, V_{OUT}=20V, I_{OUT}=1.5A		96.0		%
Output shutdown current	I_{shut}	VBAT=N*3.7V, output 5V	3.0	3.3	3.6	A
		VBAT= N*3.7V, output 9V not PD protocol	2.4	2.7	3.0	A
		VBAT= N*3.7V, output 12V, not PD protocol	1.8	2.0	2.2	A
		VBAT= N*3.7V, output PD protocol		PDO * 1.1		A
Output overcurrent detection time	T_{UVD}	output voltage is continuously lower than 2.4V		30		ms
Output short detection time	T_{OCD}	output voltage is continuously lower than 2.2V		40		μs
Control System						
Frequency	fs	Discharge switching frequency		250		kHz
		Charging switching frequency		250		kHz
VCC5V output voltage	V_{CC5V}		4.75	5	5.25	V
VCC5V output					30	mA

current						
VCCIO output voltage	V_{CCIO}		3.15	3.3	3.45	V
VCCIO output current	I_{CCIO}				30	mA
standby current	I_{STB}	VBAT=22V, Average current after one minute shutdown		80	100	μA
LED Pin drive current	I_{L1} I_{L2} I_{L3}	Voltage drop 10%	5	7	10	mA
Thermal shutdown temperature	T_{OTP}	Rising temperature	110	125	140	℃
Thermal shutdown temperature hysteresis	ΔT_{OTP}			40		℃
Resistance H-bridge power mos on-impedance	$R_{DS(ON)}$	V_{GS}=4.5V，I_D=5A		7	10	mΩ

11 Function description

11.1 Charging function

The IP2369 has a constant-current, constant-voltage lithium battery charge management system that supports a synchronous voltage switch structure.

IP2369 adopts switching charging technology with switching frequency of 250kHz.

IP2369 resistance can be set in different cell types, full of charging voltage and power, can support 2/3/4/5/6 / battery set, can support full voltage of 3.65 V / 4.1 V / 4.2 V / 4.3 V / 4.35 V / 4.4 V the different types of batteries; The maximum input charging power can reach 20V/2.25A(45W), the highest charging efficiency to 96%;

IP2369 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；

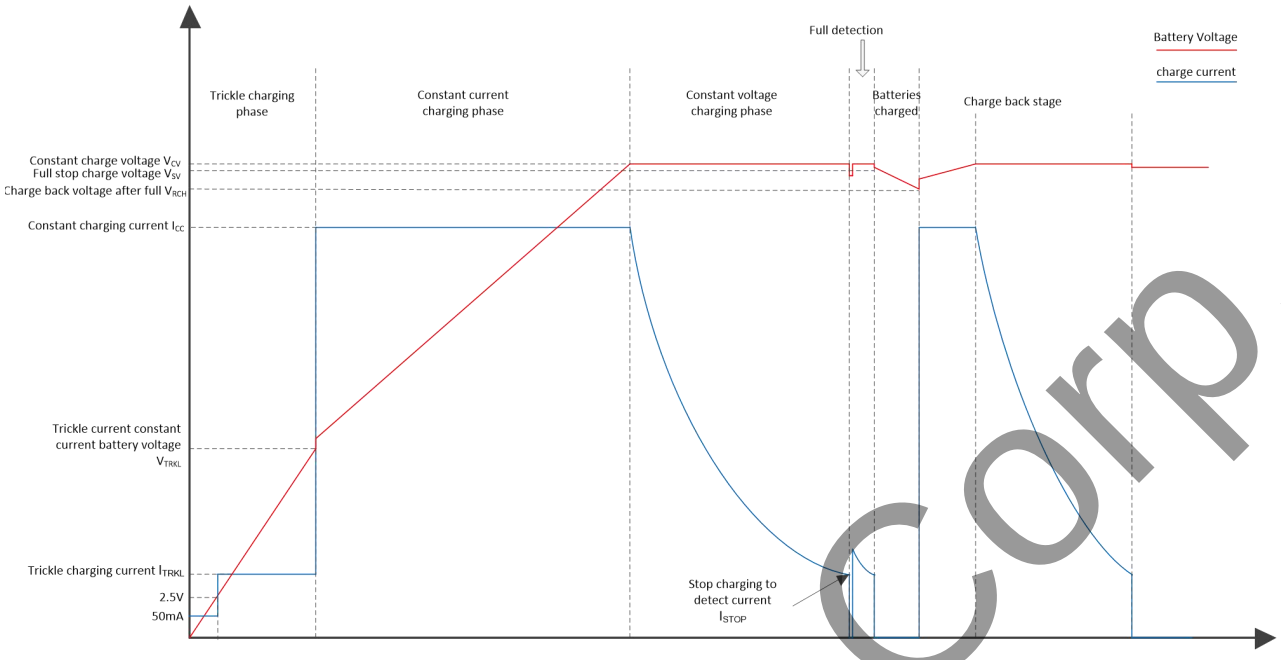


Figure 4 Battery charging process diagram

IP2369 integration has an AFC/FCP/PD2.0 PD3.0 / PD3.1 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 IP2369 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	3A
16.5<VBUS≤24V	2.25A

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

IP2369 supports Huawei FCP and Samsung AFC fast charge input protocol, when using Huawei FCP and Samsung AFC charger input charging, IP2369 will apply for the highest input voltage, constant current charging current is set according to the above input voltage gear;

IP2369 supports PD2.0/PD3.0/PD3.1 input protocol. When charging with PD fast charge adapter, IP2369 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 Discharge function

IP2369 integrates USB Type_C input and output recognition interface, automatically switches the built-in pull-down resistor, and automatically identifies the charge and discharge properties of the inserted device. With the Try.SRC function, when connected to a DRP device, the device preferentially charges the DRP.

The IP2369 supports various specifications of fast charge: PD2.0/PD3.0/PD3.1, QC2.0/QC3.0/QC3+, FCP, AFC, Apple.

IP2369 Supports identification of EMARK cables.

The IP2369 supports PD2.0, PD3.0, and PD3.1 output protocols, and supports a maximum of 45W power output.

IP2369 supports the identification of EMARK cables. Based on the identified cable information, the IP2369 broadcasts different PD packets. The PD packets in different power Settings are as follows:

Maximum output power	Output voltage and current
45W	5V/3A,9V/3A,12V/3A,15V/3A,20V/2.25A
36W	5V/3A,9V/3A,12V/3A,15V/2.4A,20V/1.8A
30W	5V/3A,9V/3A,12V/2.5A,15V/2A,20V/1.5A
27W	5V/3A,9V/3A,12V/2.25A,15V/1.8A,20V/1.35A
20W	5V/3A,9V/2.22A,12V/1.67A,15V/1.33A,20V/1A

The IP2369's USB-A1 and USB-C can support QC2.0/QC3.0/QC3+, FCP, AFC, as well as Apple's 2.4A mode and BC1.2 normal Android phone 1A mode via DP/DM pins.

11.3 Charge and Discharge Path Management

11.3.1 Standby & Light Load Shutdown

If the USB-C port is inserted into the charging power supply, the charging can be started directly.

If a USB-C UFP device is inserted into the USB-C or an electrical device is inserted into the USB-A1, the discharge function is automatically enabled.

If there is a key action, it will be turned on when there is a load connection on the USB-A1 and USB-C, otherwise it will remain off.

In multi-port output mode, when the output current of any output outlet is less than about 80mA (MOS Rds_ON@15mohm), the port will be automatically closed after 16 seconds.

When multiple electrical devices are reduced to only one electrical device, after about 16s, all output outlets will be closed first, the high-voltage fast charge function will be opened, and then the output outlet of the last electrical device will be opened, in this way to reactivate the device to request fast charge.

When only one output outlet is opened, the total output power is less than 350mW for about 32s, the output and discharge functions will be closed, and the standby state will be entered.

Under the PD protocol, the light load shutdown time is 16 minutes.

11.3.2 Discharge

If IP2369 has no key action, only the output eloquence connected to the electrical equipment will be turned on; The output of unconnected devices remains closed.

Both USB-A1 and USB-C support the output fast charge protocol. However, because the scheme is a single inductance scheme, it can only support one voltage output, so only one output outlet can support fast charge output. When two outputs are used at the same time, the fast charge function is automatically turned off.

According to the schematic diagram of Typical Application, if any output outlet has entered the fast charge output mode, when other output outlets are inserted into the power device, all output outlets are closed first, the high voltage fast charge function is disabled, and then the output outlet with the device is opened. At this time, all outputs support only Apple and BC1.2 mode charging.

11.3.3 Charging

USB-C can be charged when plugged into the power supply, and supports automatic identification of the fast charge mode of the power supply, matching the appropriate charging voltage and charging current.

11.3.4 Charging while discharging

When the charging power and electrical equipment are connected at the same time, it automatically enters the charging and discharging mode. In this mode, the chip automatically turns off the internal fast charge input request. In order to ensure the normal charging of electrical equipment, the IP2369 will increase the charging undervoltage loop to more than 4.9V to ensure the priority of power supply to electrical equipment. When the VIO voltage is only 5V, open the discharge path to supply power to the electrical equipment; For safety reasons, if the VIO voltage is greater than 5.6V, the discharge path will not be opened.

In the process of charging and discharging, if the charging power is removed, the IP2369 will turn off the charging function and restart the discharge function to supply power to the electrical device. For safety reasons, but also to be able to reactivate the electrical equipment to request a fast charge, there will be a period of time during the conversion process when the output voltage drops to 0V.

In the process of charging and discharging, if the power device is unplugged, the power device is full or stops pumping for about 16s, the IP2369 will automatically close the corresponding discharge path. When the discharge path is closed and the state returns to single charge mode, the charging undervoltage loop will be reduced, and the fast charge will be automatically re-applied to accelerate the charging of the mobile power supply.

11.4 Input and output maximum power setting

IP2369 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
18k	45W
13k	36W
9.1k	30W
6.2k	27W
3.6k	20W

11.5 Set the number of batteries in series

IP2369 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
18k	6 串
13k	5 串
9.1k	4 串
6.2k	3 串
3.6k	2 串

11.6 Battery type setting

IP2369 determines the battery type by determining the resistance value of the VSET pin connection.

RVSET	Corresponding battery type (full voltage of a single battery)
27k	4.4V
18k	4.35V
13k	4.3V
9.1k	4.2V
6.2k	4.1V
3.6k	3.65V

11.7 NTC function

IP2369 integrates the NTC function to detect the battery temperature. When IP2369 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.

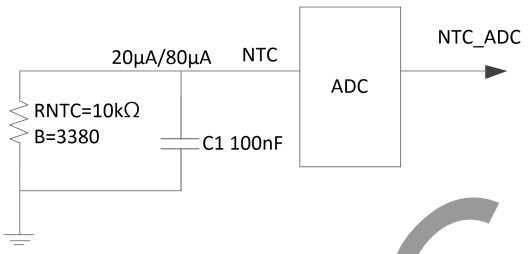


Figure 5 Comparison of battery NTC

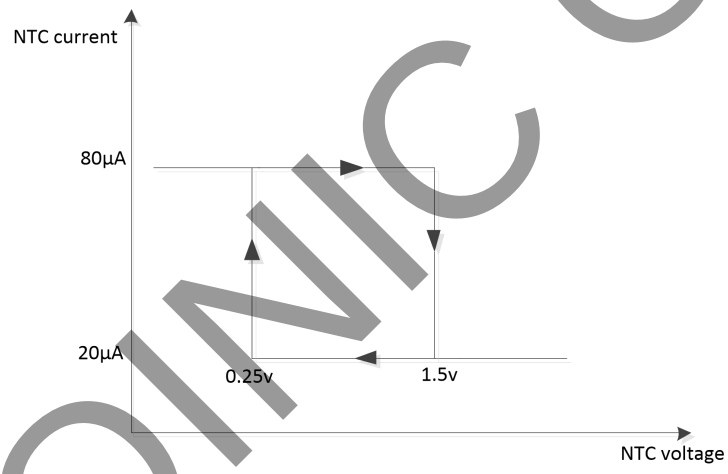


Figure 6 NTC voltage and outgoing current relationship

In order to accurately distinguish the temperature of the battery NTC, IP2369 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.

Charging state: NTC temperature below 0 degrees (0.55V) stop charging, 0~45 degrees between normal charging, temperature over 45 degrees (0.39V) stop charging.

Discharge state: When the temperature is lower than -20 degrees (1.39V), stop discharging, normal discharge between -20 degrees and 60 degrees, stop discharging above 60 degrees (0.24V);

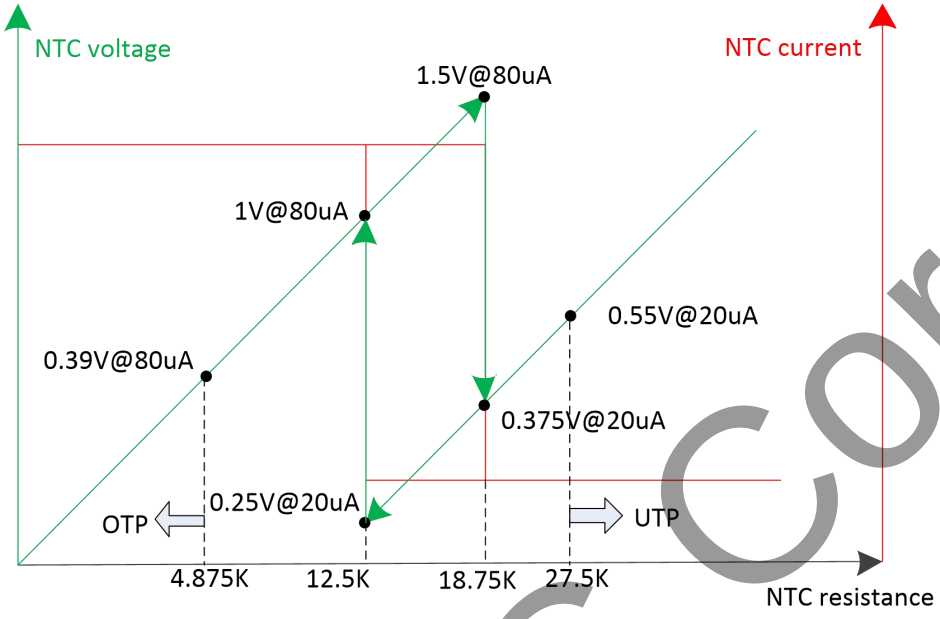


Figure 7 Relationship between NTC voltage and NTC resistance

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.

11.8 Lamp display function

IP2369 Support 4, 2, and 1 battery indicator, the connection method is as follows.

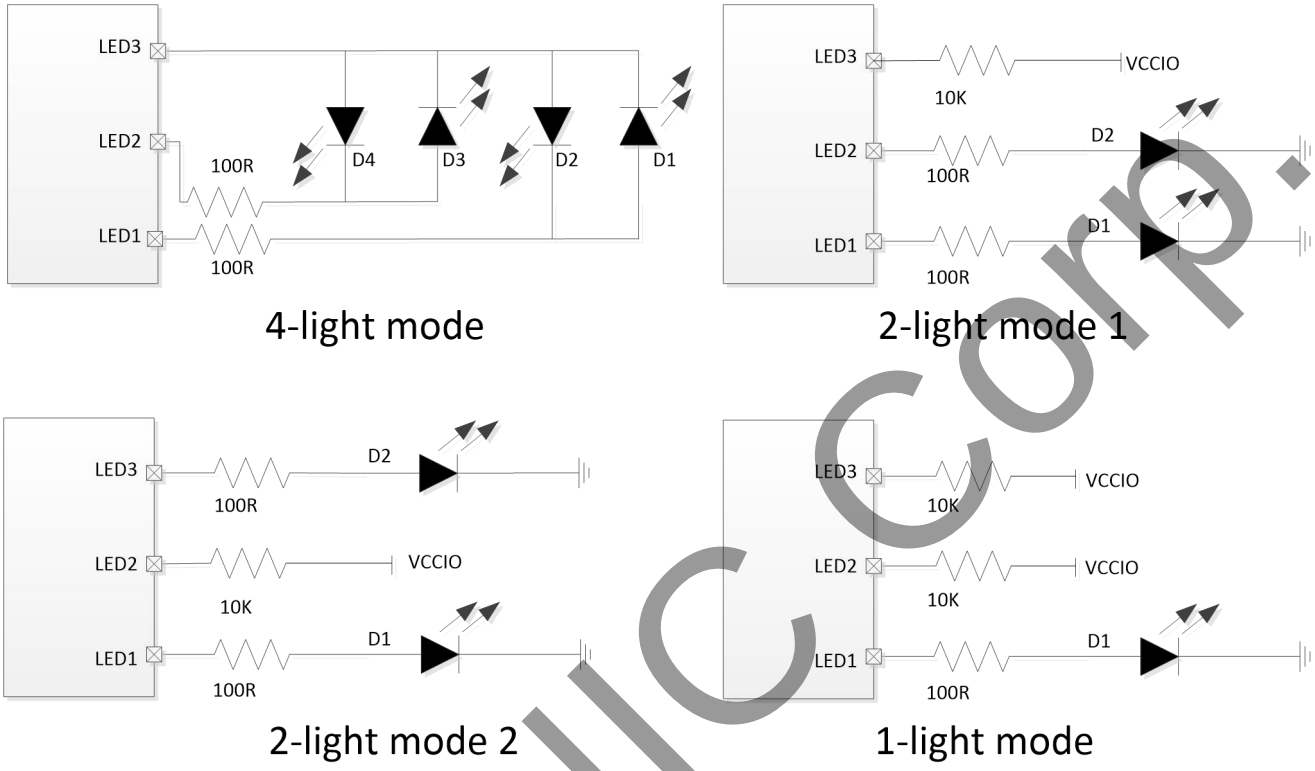


Figure 8 4, 2, 1LED connection mode

The display mode of 4 lights is:

When charging normally

Electricity C（%）	D1	D2	D3	D4
full	on	on	on	on
75%≤C	on	on	on	0.5HzFlashing
50%≤C＜75%	on	on	0.5HzFlashing	off
25%≤C＜50%	on	0.5HzFlashing	off	off
C＜25%	0.5HzFlashing	off	off	off

When discharging normally

Electricity C（%）	D1	D2	D3	D4
75%≤C	on	on	on	on
50%≤C＜75%	on	on	on	off
25%≤C＜50%	on	on	off	off
C＜25%	on	off	off	off

C=0	flash 4 times	off	off	off

After flashing 4 times (200ms on and 200ms off), stopping the discharge.

The display mode of 2 lamp mode 1 is two-color lamp:
When charging normally

Electricity C（%）	D1	D2
full	off	on
66%≤C＜100%	off	0.5HzFlashing
33%≤C＜66%	0.5HzFlashing	0.5HzFlashing
C＜33%	0.5HzFlashing	off

When discharging normally

Electricity C（%）	D1	D2
66%≤C＜100%	off	on
33%≤C＜66%	on	on
C＜33%	on	off
C=0	flash 4 times	off

After flashing 4 times (250ms on and 250ms off), stopping the discharge.

The display mode of 2 lamp mode 2 is:
D1 is on during charging, D2 is off, D1 is off when fully charged, and D2 is on; when charging is abnormal, D1 and D2 flash at the same time (on for 250ms and off for 250ms)
D1 is always on during discharge, and when C=0, D1 flashes 4 times (on for 250ms and off for 250ms) and then stops discharging.

The display mode of 1 light mode is:
D1 flashes during charging (1s on and 1s off), when fully charged, D1 is always on; D1 flashes quickly when charging is abnormal (250ms on and 250ms off)
D1 is always on during discharge, and when C=0, D1 flashes 4 times (on for 250ms and off for 250ms) and then stops discharging.

11.9 EN key function

IP2369 supports button function. The connection mode of button is shown in Figure 9.

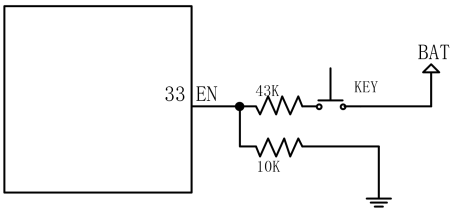


Figure 9 EN key connection mode

1.2V≤V_{EN} < 3.3V indicates a high level, 0≤V_{EN} < 1.2V indicates a low level, and the EN voltage should not exceed 5V.

The EN pin high level duration is greater than 100ms, less than 2s, that is, short press action; After entering the Standby mode, short press will turn on the power indicator and enter the no-load state. If the charging and discharging device is detected, it will enter the corresponding charging and discharging state. In the no-load state, if no charging or discharging device is detected at the port for 10s C, it will enter the Standby mode. In the no-load state, press twice within 1s to shut down and enter the Standby mode, and turn off the power indicator display and discharge output.

If the EN pin high level lasts longer than 10s, the system resets.

The EN foot cannot be suspended in the air and must be pulled down to the ground with 10K resistance.

12 Application schematic diagram

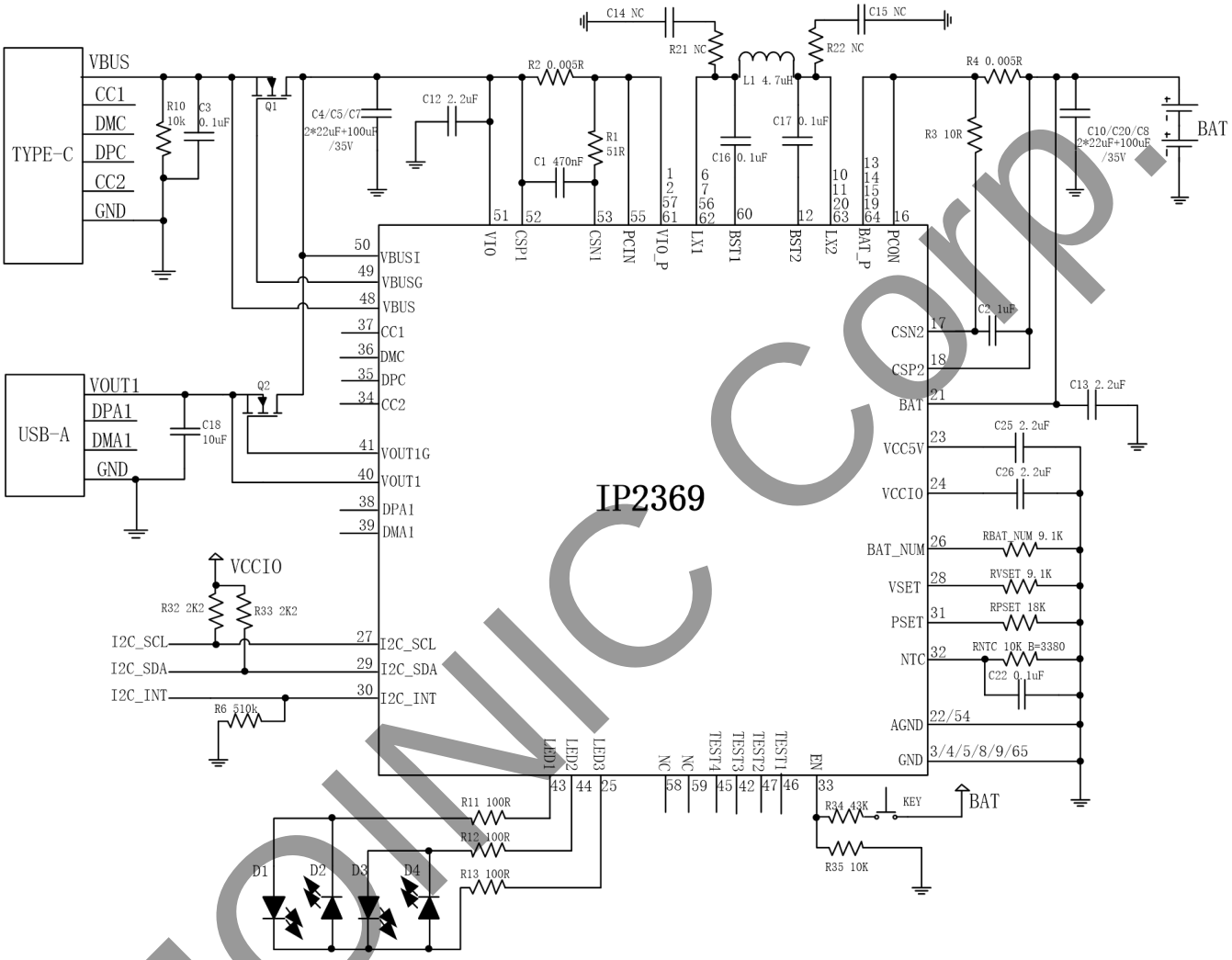
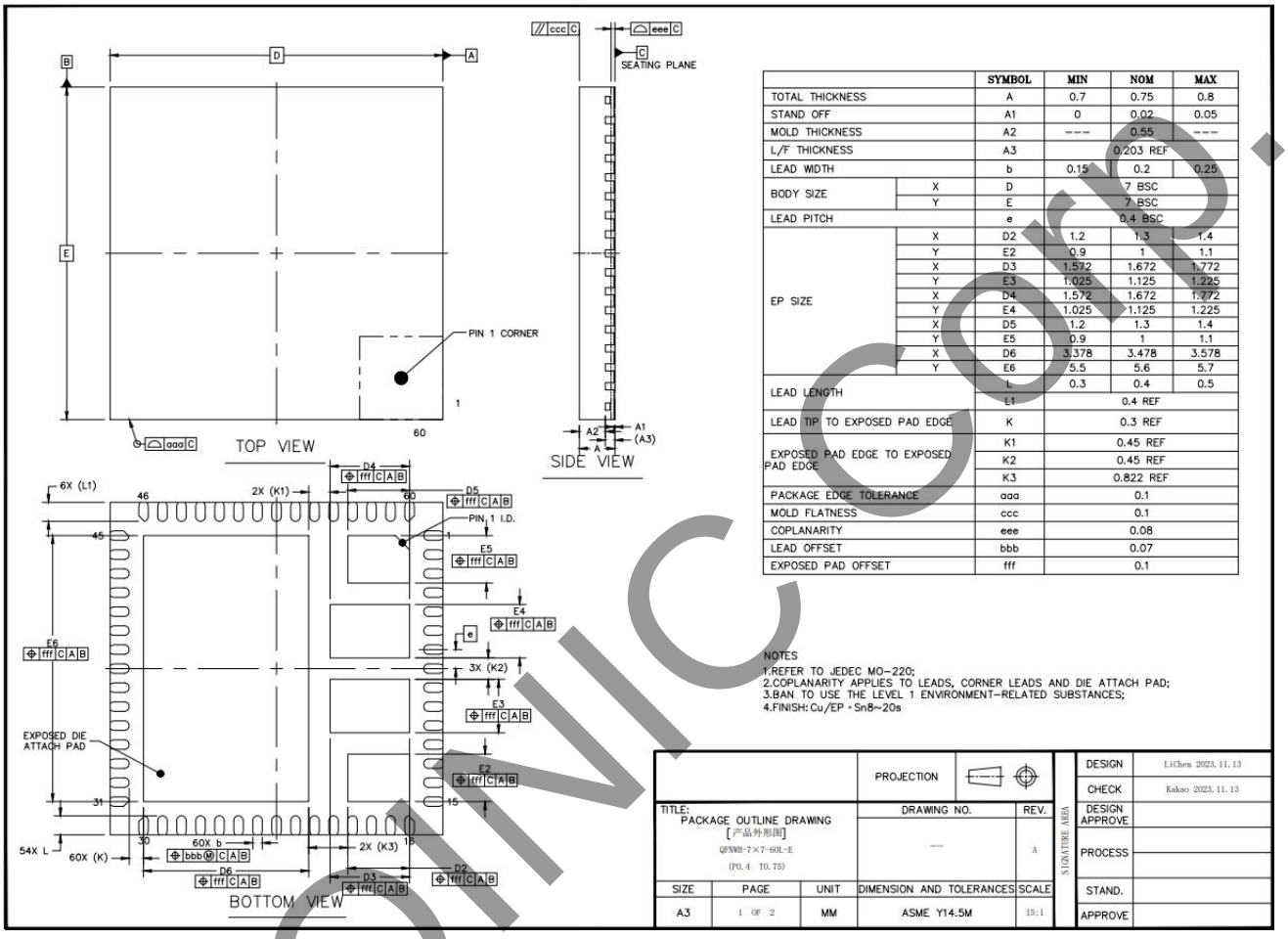


Figure 10 Application principle diagram of standard models

13 BOM

Num	Component name	Model & Specification	Location	Dosage	Remark
1	Patch IC	QFN60 IP2369	U1	1	
2	SMD capacitors	0603 100nF 10% 50V	C3,C16,C17,C22	4	
3	SMD capacitors	0603 470nF 10% 50V	C1	1	
4	SMD capacitors	0603 1μF 10% 35V	C2	1	
5	SMD capacitors	0603 2.2μF 10% 35V	C12,C13,C25,C26	4	
6	SMD capacitors	0805 10μF 10% 35V	C18	1	
7	SMD capacitors	1210 22μF 10% 35V	C4,C5,C10,C20	4	
8	Solid capacitor	100μF 35V 10%	C7,C8	2	
9	SMD resistor	1206 0.005R 1%	R2,R4	2	The sampling resistor requires a metal film resistor with high precision and low temperature
10	SMD resistor	0603 100R 5%	R11,R12,R13	3	
11	SMD resistor	0603 9.1K	RBAT_NUM	1	
12	SMD resistor	0603 18K	RPSET	1	
13	SMD resistor	0603 9.1K	RVSET	1	
14	SMD resistor	0603 10R 1%	R3	1	
15	SMD resistor	0603 43K	R34	1	
16	SMD resistor	0603 10K	R35,R10,RNTC	3	
17	SMD resistor	0603 51R	R1	1	
18	SMD LED	0603 LED	D1,D2,D3,D4	4	
19	SMD MOS	IP15N03M	Q1,Q2	2	
20	Lifting voltage inductance	4.7μH 9A R_{DC}<10mR	L1	1	
21	USB C	TYPE-C 座子	TYPE-C	1	
22	USB A	USB-A 座子	USB-A	1	
23	Tap switch	Tap switch	SW1	1	
24	SMD resistor	0603 510K	R6	1	
25	SMD capacitor	0603 3.3nF 10% 35V	C14,C15	2	NC, used for certification
26	SMD resistor	0603 2R	R21,R22	2	NC, used for certification

14 Package



		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.7	0.75	0.8
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.55	---
L/F THICKNESS		A3		0.203 REF	
LEAD WIDTH		b	0.15	0.2	0.25
BODY SIZE	X	D		7 BSC	
	Y	E		7 BSC	
LEAD PITCH		e		0.4 BSC	
EP SIZE	X	D2	1.2	1.3	1.4
	Y	E2	0.9	1	1.1
	X	D3	1.572	1.672	1.772
	Y	E3	1.025	1.125	1.225
	X	D4	1.572	1.672	1.772
	Y	E4	1.025	1.125	1.225
	X	D5	1.2	1.3	1.4
	Y	E5	0.9	1	1.1
	X	D6	3.378	3.478	3.578
	Y	E6	5.5	5.6	5.7
LEAD LENGTH		L	0.3	0.4	0.5
		L1		0.4 REF	
LEAD TIP TO EXPOSED PAD EDGE		K		0.3 REF	
EXPOSED PAD EDGE TO EXPOSED PAD EDGE		K1		0.45 REF	
		K2		0.45 REF	
		K3		0.822 REF	
PACKAGE EDGE TOLERANCE		aaa		0.1	
MOLD FLATNESS		ccc		0.1	
COPLANARITY		eee		0.08	
LEAD OFFSET		bbb		0.07	
EXPOSED PAD OFFSET		fff		0.1	

Figure 11 Package

15 Silkscreen

Figure 12 Silkscreen

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