Support PD3.0 and other fast charging input/output protocols, support 2~5 sections of series-connected batteries with integrated lift voltage drive Power management chip with maximum charging/discharging power of 100W.

1 characterization

- **Charge and Discharge Specifications**
  - ✧ Integrated BUCK-BOOST Buck-and-Boost Power NMOS Driver
  - ✧ Charging and discharging power max. 100W
  - ✧ □□□□□□□□□ charge current regulation
  - ✧ □□□ external resistor can set the full voltage, the single lithium battery full voltage can be set in the range of: 4.1V~4.4V, the single lithium iron phosphate battery full voltage can be set: 3.5V~3.7V
  - ✧ External resistor can set the maximum charging and discharging power, maximum support 100W
  - ✧ External resistor selection 2/3/4/5 section series cell charging
- **Fast charging specifications**
  - ✧ Integrated FCP input/output fast charging protocol
  - ✧ Integrated AFC input/output fast charging protocol
  - ✧ Integrated SCP input/output fast charging protocol
  - ✧ Integrated DRP Try.SRC protocol, PD3.0 input/output fast charging protocol
  - ✧ Integrated QC2.0/QC3.0/QC3.0+ output fast charging protocols
- **Battery level display**
  - ✧ Built-in 14bit ADC and power meter
  - ✧ Self-learning power meter with more even power display
  - ✧ Initial Battery Capacity PIN Optional Configuration
- **Other Functions**
  - ✧ 4/2/1 LED Power Indicator
  - ✧ Supports NTC battery temperature detection
  - ✧ Supports I2C function
- **Multi-protection, high reliability**
  - ✧ Input overvoltage and undervoltage protection
  - ✧ Output overcurrent and short circuit protection
  - ✧ Battery overcharge, overdischarge, overcurrent protection
  - ✧ IC Over Temperature Protection
  - ✧ Rechargeable Battery Temperature NTC Protection
  - ✧ ESD 4KV, input (with CC/DP/DM pins) withstand voltage 30V
- **Package size: 7mm × 7mm 0.5pitch QFN48**

2 Application Products

- **Charge/discharge 2~5 strings of Li-Ion/ Li-FePO4 batteries**

3 summary

IP2368 is an integrated AFC/FCP/PD2.0/PD3.0 etc. Li-ion battery charge/discharge management chip with input/output fast charging protocol and synchronous boost converter;

The high integration and rich functionality of IP2368 requires only one inductor to realize the synchronous buck-boost function, which requires very few peripheral devices, effectively reducing the size of the overall solution and lowering the BOM cost. The IP2368 supports 2/3/4/5 cells in series and can be connected externally. Resistor to select the number of battery series; IP2368 supports external resistor to select ordinary lithium batteries or lithium iron phosphate batteries, the external resistor can be set to full voltage, lithium battery full voltage can be set to: 4.15V/4.2V/4.3V/4.35V/4.4V, lithium iron phosphate battery full voltage can be set to: 3.5V/3.55V/3.6V/3.65V/3.7V, lithium iron phosphate battery full voltage can be set to: 3.5V/3.55V/3.6V/3.65V/3.7V. V.

The IP2368's synchronous switching charge/discharge system provides up to 100W of charge/discharge power, and the maximum charge/discharge power can be set by an external resistor.The IP2368 has a built-in detection loop for IC temperature, battery NTC temperature, and input voltage control, which allows it to intelligently adjust the charge current according to the different power chargers.

The IP2368 has a built-in 14bit ADC, which can accurately measure the charging input voltage and current, battery voltage and current.The IP2368 has a built-in power meter algorithm, which can get the battery power, charging voltage, charging current and other information through I2C.

IP2368 supports 4 power indicators, customizable to support 188

Digitizer.

catalogs

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4 edit a record

Note: Page numbers in previous versions may differ from those in the current version.

Changes V1.40 to V1.41 (November 2023)	Page
● Charging currents for charging gears specified at different power levels....................................	11
● Modify datasheet format	

Changes V1.35 to V1.40 (November 2023)	Page
● No longer supports up to 6 strings of lithium battery applications	

5 Simplified Application Schematic

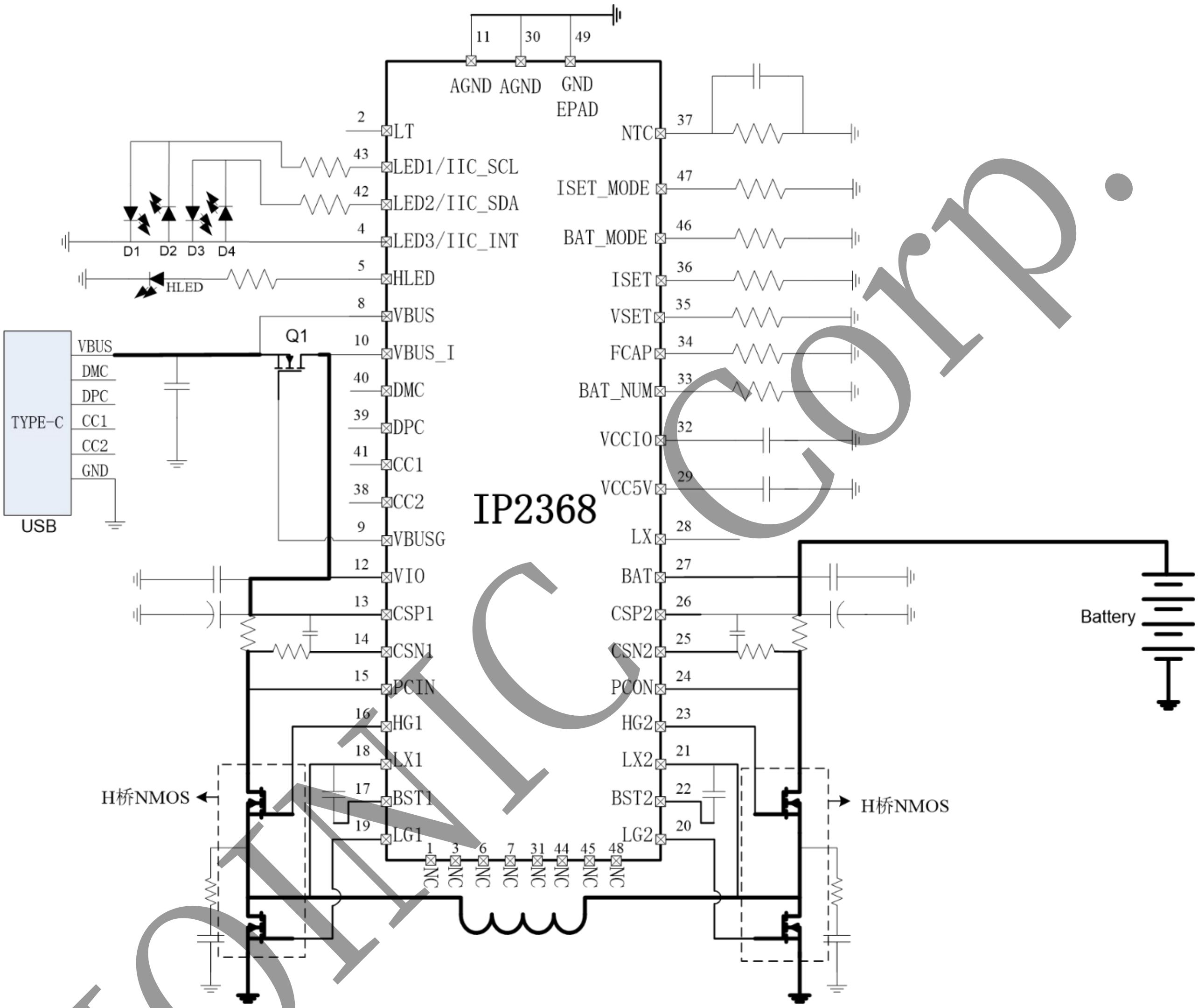


Figure 1 IP2368 Simplified Application Schematic

6 Description of common customized models

model number	Functional Description
IP2368_BZ	Standard IP2368, supports 2-5 battery charging
IP2368_COUT	Addition of C port discharge output function to IP2368 standard product.
IP2368_I2C_COUT	Based on IP2368_COUT, remove the lamp display and change to I2C function, which can be used as an I2C slave device.
IP2368_NF	Can be upgraded to any other model
IP2368_NACT	Removal of charge activation based on IP2368_COUT
IP2368_I2C_NACT	Remove charge activation based on IP2368_I2C_COUT

7 Pin Definitions

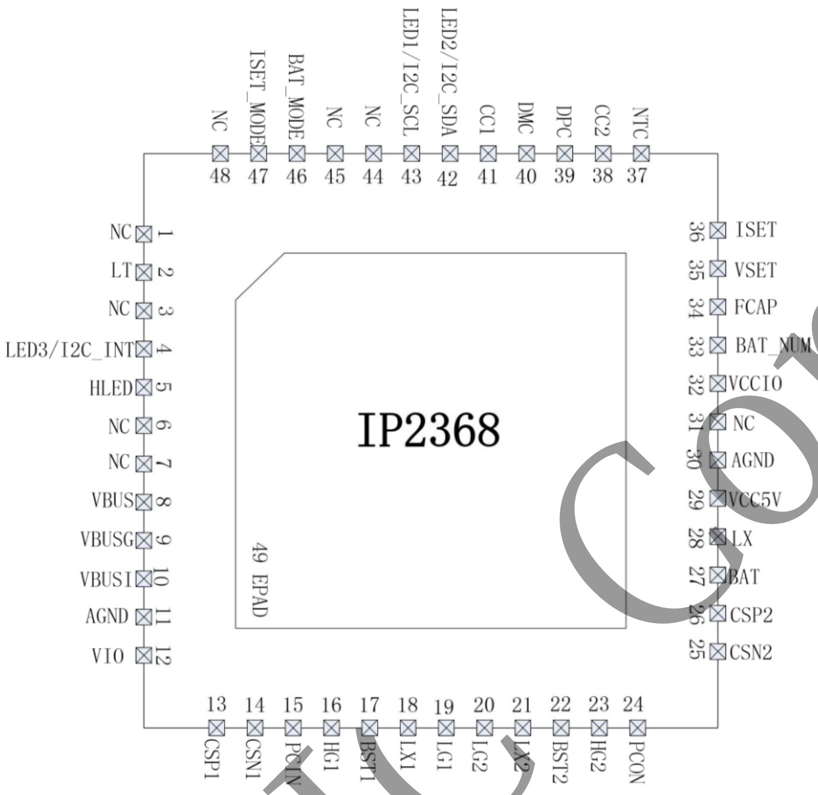


Figure 2 IP2368 Pinout

7.1 IP2368 Pinout

Pin Num	Pin Name	PIN Definition Description
1	NC	Undefined pin, left dangling
2	LT	Lighting Decoder Pins
3	NC	Undefined pin, left dangling
4	LED3/I2C_INT	Charging status LED output indicator pin 3, I2C model is I2C_ INT signal.
5	HLED	Fast charging indicator pin, outputs high level after successful fast charging protocol handshake
6	NC	Undefined pin, left dangling
7	NC	Undefined pin, left dangling
8	VBUS	VBUS Input Detect Pin
9	VBUSG	VBUS Input Path NMOS Control Pin
10	VBUS_I	VBUS Input Path Current Sense Pin

11	AGND	analogically
12	VIO	Power Input Pin
13	CSP1	Input Current Sampling Positive
14	CSN1	Input Current Sampling Negative
15	PCIN	Input Peak Current Sampling Pin
16	HG1	H-Bridge Power Tube Input Up Control Pin
17	BST1	H-Bridge Power Tube Input Bootstrap Voltage Pin
18	LX1	Input inductor connection pin
19	LG1	H-Bridge Power Tube Input Lower Tube Control Pin
20	LG2	H-Bridge Power Tube Output Battery Lower Control Pin
21	LX2	Battery Side Inductor Connection Pin
22	BST2	H-Bridge Power Tube Battery Side Bootstrap Voltage Pin
23	HG2	H-Bridge Power Tube Battery Side Up Control Pin
24	PCON	Battery-side peak current sampling pin
25	CSN2	Battery-side average current sampling negative
26	CSP2	Positive battery-side current sampling
27	BAT	Battery supply pins
28	LX	System 5V supply BUCK output inductance connection point, default suspended
29	VCC5V	System 5V supply to power internal IC analog circuits
30	AGND	analogically
31	NC	Undefined pin, left dangling
32	VCCIO	System 3.3V supply to power internal IC digital circuitry
33	BAT_NUM	Battery series section selection, connect different resistors to select different series sections
34	FCAP	Battery capacity selection, connect different resistors to select different battery capacity
35	VSET	Battery full voltage selection, connect different resistors, you can select different rechargeable battery voltage
36	ISET	Constant current charging power or charging current setting
37	NTC	NTC Resistance Detection Pin
38	CC2	USB C port detection and fast charging communication pin CC2
39	DPC	USB C Port Fast Charge Smart Recognition DP
40	DMC	Intelligent recognition of USB C port fast charging

		DM
41	CC1	USB C port detection and fast charging communication pin CC1
42	LED2/I2C_SDA	Charging status LED output indicator pin 2, I2C model is I2C_SDA signal.
43	LED1/I2C_SCL	Charging status lamp output indicator pin 1, I2C model is I2C_SCL signal.
44	NC	Undefined pin, left dangling
45	NC	Undefined pin, left dangling
46	BAT_MODE	Battery type selection, grounded selection of lithium iron phosphate, suspended or connected high selection Common lithium battery
47	ISET_MODE	ISET Current Setting Mode Selection, Ground Selection ISET Setting Battery Side Constant Current Charging, Suspend or Connect High Selection ISET Setting Charge Input Power
48	NC	Undefined pin, left dangling
49 (EPAD)	GND	System ground and thermal ground, need to maintain good contact with GND

8 Internal Block Diagram

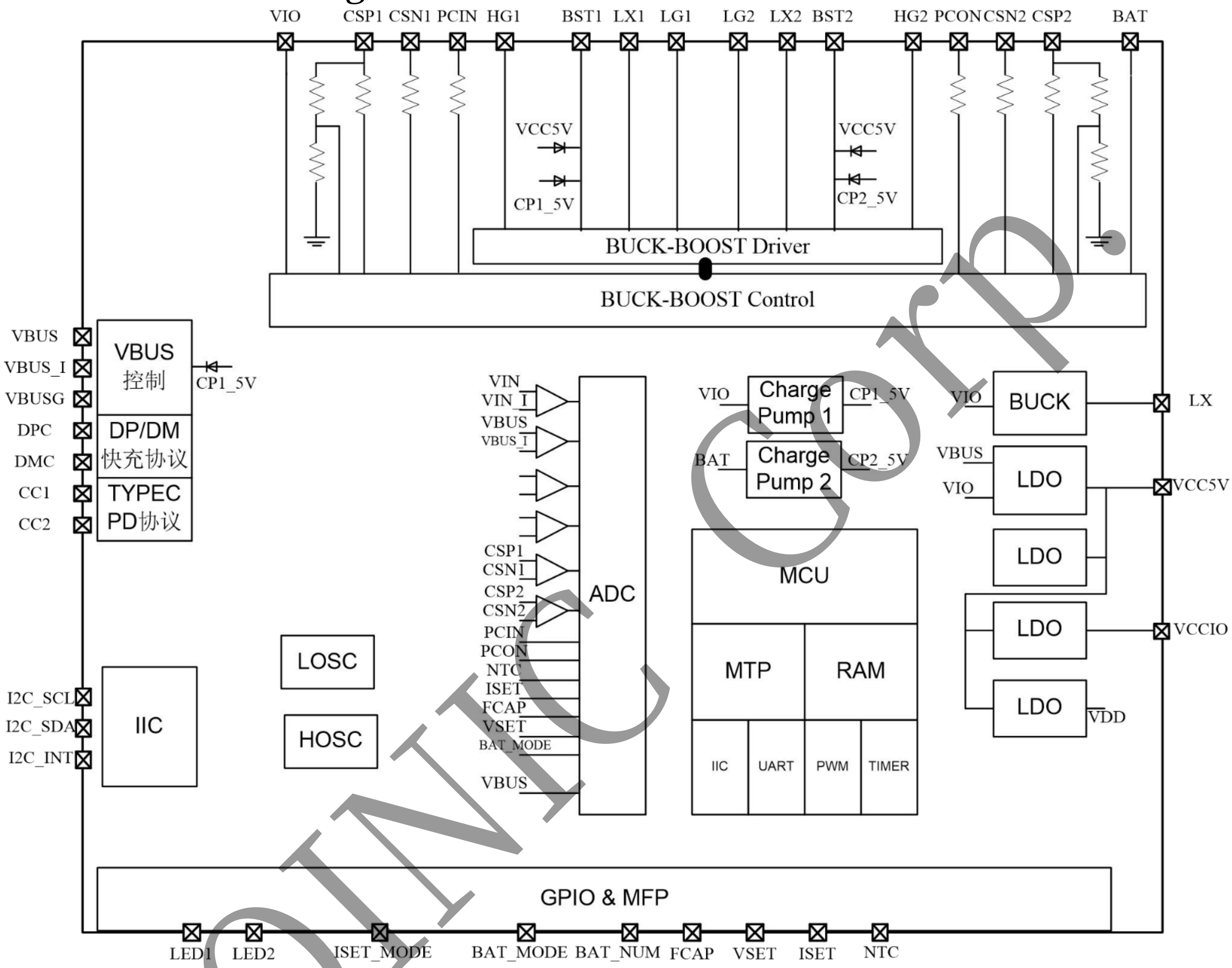


Figure 3 Internal block diagram of the chip

9 limit parameter

parameters	notation	(be) worth	unit (of measure)
Port Voltage Range	VBAT/VVBUS	-0.3 ~ 30	V
Protocol Interface Voltage Range	vdmc/dpc/vcc1/cc2	-0.3 ~ 30	V
Digital GPIO Voltage Range	VLED/VGPIO	-0.3 ~ 8	V
Junction temperature range	TJ	-40 ~ 125	℃
Storage temperature range	Tstg	-60 ~ 150	℃
Thermal resistance (junction temperature to ambient)	θJA	30	℃/W
Human Body Model (HBM)	ESD	4	KV

* Stresses above the values listed in the Absolute Maximum Ratings section have the potential to cause permanent damage to the device under any Absolute Maximum Ratings condition.
Any prolonged exposure may affect the reliability and lifetime of the device.

10 Recommended working conditions

parameters	notation	minimum value	typical value	maximum values	unit (of measure)
Input Voltage	VBUS	4.5		25	V
Battery Voltage	VBAT			25	V
Operating Temperature	TA	-40		85	℃

* Beyond these operating conditions, the device operating characteristics are not guaranteed.

11 Electrical Characteristics

Unless otherwise noted, TA=25°C, L=10uH

parameters	notation	test condition		minimum value	typical value	maximum values	unit (of measure)
charging system							
Input Voltage	VBUS			4.5	5/9/12/15/20	25	V
Input overvoltage	VBUS	Rising Voltage				25	V
Charging constant voltage	VTRGT	BAT_MODE is suspended to select normal lithium battery VTRGT=4000+0.02*RVSET (in mV) step=10mV	RVSET = 7.5K	N*4.11	N*4.15	N*4.19	V
			RVSET = 10K	N*4.16	N*4.20	N*4.24	V
			RVSET = 15K	N*4.26	N*4.30	N*4.34	V
			RVSET = 17.5K	N*4.31	N*4.35	N*4.39	V
			RVSET ≥20K	N*4.36	N*4.40	N*4.44	V
		BAT_MODE Ground, select lithium iron phosphate battery VTRGT=3500+0.01*RVSET in mV step=10mV	RVSET = 5K	N*3.51	N*3.55	N*3.59	V
			RVSET = 10K	N*3.56	N*3.60	N*3.64	V
			RVSET = 15K	N*3.61	N*3.65	N*3.69	V
			RVSET ≥20K	N*3.66	N*3.70	N*3.74	V
Charging Current	ICHRG	VBUS=5V, input current		2.7	3.0	3.3	A
		VBUS=9V. Non-PD fast charging. Input Current	PMAX≥20W	1.8	2.0	2.2	A
		VBUS=9V. PD fast charging. Input Current	PMAX=20W	1.8	2.0	2.2	A
			PMAX≥30W	2.7	3.0	3.3	A
		VBUS=12V. Non-PD fast charging. Input Current	PMAX≥20W	1.3	1.5	1.7	A
		VBUS=12V. PD fast charging. Input Current	PMAX=20W	1.3	1.5	1.7	A
			PMAX=30W	2.0	2.25	2.5	A
			PMAX≥45W	2.7	3	3.3	A
		VBUS=15V,PD and non PD. Input Current	PMAX=20W	1.1	1.3	1.5	A
			PMAX=30W	1.8	2.0	2.2	A
			PMAX≥45W	2.7	3.0	3.3	A
		VBUS=20V.	PMAX=20W	0.8	1.0	1.2	A
			PMAX=30W	1.3	1.5	1.7	A

		VBUS=20V. Non-PD fast charging, input current	PMAX=20W	0.8	1.0	1.2	A
			PMAX=30W	1.3	1.5	1.7	A
			PMAX=45W	2.0	2.25	2.5	A
			PMAX≥60W	2.7	3.0	3.3	A
		ISET_MODE Ground, select ISET to set the maximum battery current for constant current charging ICHRG=0.2*RISET (in mA) step=100mA	RISET= 5K		1		A
			RISET= 10K		2		A
			RISET= 12.5K		2.5		A
			RISET= 15K		3		A
			RISET ≥ 25K		5		A
peak current	IL_PK	Inductive Peak Current Limit				10	A
Trickle charge current	ITRKL	VIN=5V, VBAT<2.5V		30	50	70	mA
		VIN=5V, 2.5V<=VBAT<VTRKL		100	200	300	mA
Trickle-down voltage	VTRKL	BAT_MODE pin NC is suspended to select normal lithium Battery with N battery cells		N*2.9	N*3	N*3.1	V
		BAT_MODE pin is grounded, selecting LiFePO4 Li-ion battery with N battery cells		N*2.4	N*2.5	N*2.6	V
Charge Stop Charge Flow	ISTOP				100		mA
recharge threshold	VRCH	The number of battery sections is N			VTRGT - N*0.1		V
Charging Deadline	TEND			45	48	51	Hour
Discharge system							
Battery operating voltage	VBAT	The number of battery sections is N		N*2.75		N*4.5	V
Switching Operating Battery Input Current	IBAT	VBAT=4*3.7V, VOUT=5.0V. fs=250kHz, Iout=0mA		3	7		mA

DC Output Voltage	QC2.0 VOUT	VOUT=5V@1A	4.75	5.00	5.25	V
		VOUT=9V@1A	8.70	9	9.30	V
		VOUT=12V@1A	11.60	12	12.40	V
	QC3.0/ QC3+ VOUT	@1A	3.6		12	V
	QC3.0 Step			200		mV
	QC3+ Step			20		mV
Output Voltage Ripple	ΔVOUT	VBAT=4*3.7V. VOUT=5.0V. fs=250KHz, Iout=1A		120		mV
		VBAT=4*3.7V. VOUT=9.0V VBAT=4*3.7V, VOUT=9.0V		135		mV
		fs=250KHz, Iout=1A				
		VBAT = 4*3.7V. VOUT=12V, fs=250KHz, Iout=1A		370		mV
Discharge system max. output power	Pmax	Under the PD protocol, different PMAX resistor values correspond to different Same as Pmax	20		100	W
Discharge system efficiency	ηout	VBAT=8V, VOUT=5V. IOUT=2A		94.69		%
		VBAT=8V, VOUT=9V. IOUT=2A		95.36		%
		VBAT=8V, VOUT=12V. IOUT=2A		95.86		%
		VBAT=15V, VOUT=5V. IOUT=2A		91.55		%
		VBAT=15V, VOUT=9V. IOUT=2A		95.05		%
		VBAT=15V, VOUT=12V. IOUT=2A		95.37		%
Discharge system overcurrent shutdown current	Ishut	VBAT=N*3.7V,Output 5V	3.1	3.4	3.8	A
		VBAT= N *3.7V, output 9V, non-PD state	2.7	3	3.3	A
		VBAT= N *3.7V, output 12V, non-PD state	2	2.2	2.5	A
		VBAT= N *3.7V, output PD state		PDO * 1.1		A
Load overcurrent	TUVD	Output voltage consistently below		30		ms

detection timing		2.4V				
Load short circuit detection timing	TOCD	Output voltage consistently below 2.2V		40		us
control system						
switching frequency	fs	Discharge switching frequency		250		kHz
		Charge switching frequency		250		kHz
VCCIO Output input voltage	VCCIO		3.15	3.3	3.45	V
VCCIO Output amps	ICCIO		25	30	35	mA
Battery-side standby power stream of water or sth. resembling one	ISTB	VBAT = 14.8V, average current after key off		180		uA
LED display drive current	IL1 IL2 IL3	Voltage drop 10%	5	7	9	mA
Thermal shutdown temperature	TOTP	rising temperature	110	125	140	℃
thermal shutdown temperature is late sluggish	ΔTOTP			40		℃

12 Functional Description

12.1 Charging process

IP2368 has a constant-current, constant-voltage lithium battery charge management system that supports synchronized switching structure.

The IP2368 utilizes switching charging technology with a switching frequency of 250kHz.

IP2368 can set different battery types, full voltage and charging current through external resistors, and can support 2/3/4/5 strings of LiFePO4 or Li-ion battery charging, with a maximum charging current of up to 5A or 100W charging input, and charging efficiency of up to 96%;

The IP2368 supports the trickle-constant-current-constant-voltage charging process:

When the battery voltage VBAT≤ 2.5V, it is a small-current trickle charge, and the battery charge current is about 100mA;

When the battery voltage is 2.5V <VBAT≤ $_{VTRKL}$, it is trickle charging, and the battery charging current is about 200mA; when BAT_MODE is suspended, the trickle charging cutoff voltage $_{VTRKL}$ is N*3V; when BAT_MODE is grounded, the trickle charging cutoff voltage $_{VTRKL}$ is N*2.5V;

When the battery voltage VTRKL<VBAT< $_{VTRGT}$, it is constant-current charging, and the charging current charges the battery according to the set constant-current charging current; the full voltage $_{VTRGT}$ and the constant-current charging current can be set by external $_{RVSET}$ and $_{RISET}$;

When the battery voltage $_{VBAT}$ = $_{VTRGT}$, the battery voltage rises close to the full voltage, the charging current will slowly decline, into the constant voltage charging; into the constant voltage charging, when the battery charging current is less than the $_{ISTOP}$ (100mA) and the battery voltage is close to the constant voltage, the charging stops and the full Turn to full state.

After full charge and stop charging, it will continue to detect the battery voltage and restart charging when the battery voltage is lower than $_{VBAT}$ < $_{VTRGT}$ - N*0.1V;

The IP2368 can be customized with different trickle charge cut-off voltages, $_{VTRKL}$, as well as a 0V battery disable charging function;

IP2368_COUT defaults to require charging activation before external discharge after the battery is connected for the first time; it can be customized to remove the charging activation function: IP2368_NACT and IP2368_I2C_NACT;

12.2 Type_C PD

IP2368 integrates USB Type_C input and output recognition interface, automatically switches the built-in pull-up and pull-down resistors, and automatically recognizes the charging and discharging attributes of the plugged-in device. With Try.SRC function, it can prioritize charging to the other party when the other party is connected as a DRP device.
IP2368 supports PD2.0/PD3.0 bi-directional input/output protocol. The IP2368 supports maximum 100W power output, 5V, 9V, 12V, 15V, 20V input and 5V, 9V, 12V, 15V, 20V output.IP2368 can be

customized to realize PPS output function;

12.3 fast charging function

IP2368 Supports multiple specifications of fast charging forms: QC2.0/QC3.0/QC3+, FCP, AFC, SCP, Apple.
Charging the battery input can support fast charging inputs such as FCP, AFC, etc. Since FCP, AFC are fast charging handshake requests through DP/DM, when other fast charging protocol ICs are added, FCP, AFC fast charging can no longer be supported.

IP2368 integrates AFC/FCP/ PD2.0/PD3.0 input fast charging protocol, which can apply fast charging voltage to the fast charging adapter through DPC/DMC/CC1/CC2 on the TypeC port, and will automatically adjust the charging current level to adapt to the adapters with different loading capacity.
When charging with a normal 5V charger or power supply without fast charging, the maximum maximum charging current at the input is set to 3A;
When charging with a charger that has only Huawei FCP or Samsung AFC fast charging protocol, but not PD fast charging, the maximum charging power on the input side is limited to

18W (9V/2A, 12V/1.5A);
When charging with a PD fast charging adapter, the maximum input charging power is limited according to the received PD packet, when the received PD packet power is less than the ISET When the set power of the charging demand, it will actively reduce the charging current so that the maximum power on the input is less than or equal to the PD broadcast power given by the adapter;

Example 1: ISET_MODE is suspended, RISET=15K to set the maximum input power at 60W for constant current charging. If the IP2368 is charged with a 30W PD adapter, the input charging current will be limited to 30W; only when the IP2368 is charged with a PD adapter of 60W or above, the power at the input will reach the set 60W;

Example 2: ISET_MODE ground, RBAT_NUM=9.1K, 3 series battery charging, RISET=15K, set the maximum charging current of the battery side is 3 A ,with30W PD adapter to IP2368 charging, and successfully enter the PD fast charging, do not take into account the charging conversion efficiency, in the battery voltage VBAT<10V, the charging power less than 30W, does not reach the maximum output power of the adapter, the battery charging current can ensure 3A constant current charging; when the battery voltage VBAT>10V, the power required for charging has been greater than 30W, exceeding the PD adapter Without considering the charging conversion efficiency, when the battery voltage VBAT<10V, the charging power is less than 30W, the maximum output power of the adapter has not been reached, and the battery charging current can be guaranteed to be 3A constant current charging; when the battery voltage VBAT>10V, the power required for charging is already greater than 30W, which is more than the maximum output power of the PD adapter, so it will automatically reduce the battery charging current, so as to maintain the input power at 30W;

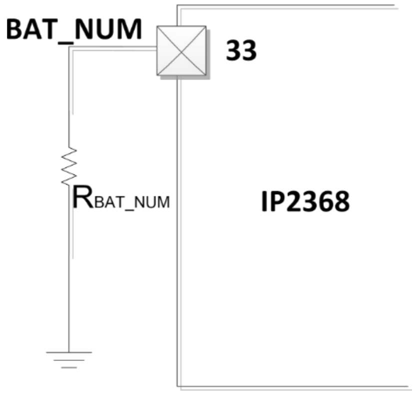
If the charging input is a fixed voltage input and not an adapter is used, a customized version of IP2368_NA can be used;
The customized model of IP2368_NA will charge according to the input power or battery charging current set by the ISET pin regardless of the adapter power, and will not automatically reduce the charging power or charging current, but it is necessary to make sure that the charging input's power load capacity is greater than the set charging maximum power;

When the battery is discharged externally, it automatically detects the fast charging timing on the DP and DM pins, and intelligently recognizes the type of cell phone, which can support cell phones with QC2.0/QC3.0/QC3+, FCP, AFC, and SCP protocols, as well as the 2.4A mode for Apple cell phones, and the 1A mode for BC1.2 common Android cell phones.

12.4 Battery series connection number setting

The IP2368 supports charging of 2/3/4/5 string batteries;
The IP2368 has the option to set the number of battery sections in series by connecting different resistors externally to the BAT_NUM pin;
The relationship between the external resistance of BAT_NUM pin R_{BAT_NUM} and the number of cells in series is as follows:

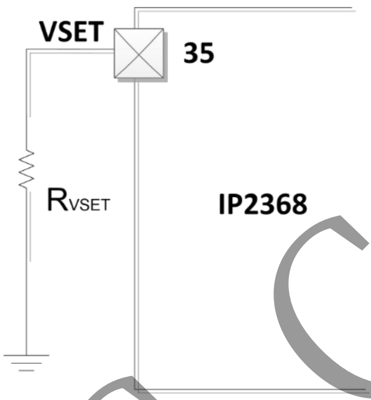
R_{BAT_NUM} (欧姆)	设定电池串联节数 (串)
6.2k	2串
9.1k	3串
13k	4串
18k	5串



When the RBAT_NUM resistance is greater than 33K, it will be detected that the RBAT_NUM resistance is open-circuit, and the charging status indicator will alarm abnormally in order to ensure the charging safety;

12.5 Battery type and full voltage setting

The BAT_MODE pin of IP2368 is left empty to select normal lithium battery, the full voltage range of a single battery is 4.1V~4.4V; BAT_MODE
Connect a 1K resistor to ground at the VSET pin, select lithium iron phosphate battery, the full voltage range of a single battery is 3.5V~3.7V; the relationship between the resistance of VSET pin to ground, RVSET, and the set full voltage is as follows:



RBAT_MODE悬空,普通锂电池		RBAT_MODE接地,磷酸铁锂电池	
单节电池充满电压 V_{TRGT}=4000+0.02*R_{VSET} 单位mV step=10mV	R_{VSET}	单节电池充满电压 V_{TRGT}=3500+0.01*R_{VSET} 单位mV step=10mV	R_{VSET}
4.15V	7.5K	3.55V	7.5K
4.20V	10K	3.60V	10K
4.30V	15K	3.65V	15K
4.35V	17.5K	3.70V	≥20K
4.40V	≥20K		

Attention:

1, RVSET set single battery full voltage, the actual BAT output voltage should also be multiplied by the number of battery sections;

2、Single battery full voltage voltage setting step is 10mV, in order to ensure the accuracy, RVSET to use 1% precision resistor;

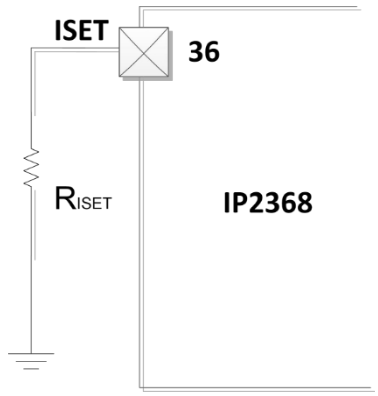
3、When RVSET resistance is greater than 33K, it will be detected that RVSET resistance is open-circuit, to ensure the charging safety, the charging status indicator will be abnormal alarm;

12.6 Charge current setting

The IP2368 can set the charge current via the ISET pin;
When the ISET_MODE pin is suspended, the ISET pin is set to the maximum input power during charging. During constant-current charging, the input voltage and current remain constant, and the charging current at the battery side decreases as the battery voltage rises;

When the ISET_MODE pin is connected to a 1K resistor to ground, the ISET pin sets the charging current at the battery side, which remains constant with sufficient input load capacity, and the current and power at the input side become larger as the battery voltage rises;

The relationship between the ISET pin resistance $_{RISET}$ and the set input and output power or charging current is as follows:



ISET_MODE悬空 RISET设置恒流最大输入功率		ISET_MODE接地 RISET设置恒流最大电池电流	
充电时的最大输入功率 P_{CCIN}=4*R_{ISET} 单位mW step=1W	R_{ISET}	单节电池充满电压 I_{CHRG}=0.2*R_{ISET} 单位mA step=100mA	R_{ISET}
20W	5K	1A	5K
30W	7.5K	2A	10K
45W	11.2K	2.5A	12.5K
60W	15K	3A	15K
100W	⩾25K	5A	⩾25K

Attention:

1. When setting the input power, the minimum step is 1W and the maximum input power is 100W; when setting the battery current, the minimum step is 100mA and the maximum input current is 5A; after the RISET is larger than 25K, it will be set to the maximum 100W or 5A charging;

2、When the RISET resistance is greater than 33K, it will be detected that the RISET resistance is open-circuit, and in order to ensure the charging safety, the charging status indicator will be abnormally alarmed;

3、The standard product will automatically adjust the charging current according to the power supply capacity of the charger used; if the power supply capacity of the charger used is less than the RISET

The set charging power automatically reduces the charging current;

4. If the input power is not a 3rd party charger but a fixed input power, you can use the customized model of P2368_NA, which will not automatically reduce the charging current according to the charger power supply capacity;

IP2368_COUT supports the C port discharge output function. The PDO of the discharge output can also be set through the ISET pin, and the specific setting method of the output power:

22.5K≤RISET<33K, output power is set to 100W;
12.5K≤RISET<22.5K, output power is set to 60W;
10K≤RISET<12.5K, output power is set to 45W;
7K≤RISET<10K, output power is set to 30W;
5.8K≤RISET<7K, output power is set to
25W; RISET<5.8K, output power is set
to 20W;

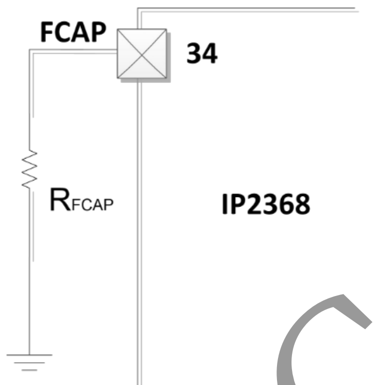
When the power setting is greater than 60W, the output broadcasting capacity will be limited to a maximum of 60W when the E-MARK cable is not recognized, and the output PDO: 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/3A; the output broadcasting capacity will be limited to a maximum of 100W when the E-MARK cable is recognized (with the addition of EMARK circuitry) and the output PDO: 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/5A; and the output broadcasting capacity will be limited to a maximum of 100W when the E-MARK cable is recognized (with the addition of EMARK circuitry). Output PDO: 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/5A;

12.7 galvanometer

The IP2368 has a built-in power meter function for accurate battery power calculations.

The IP2368 supports externally setting the capacity of the cell and utilizes the integral of the cell end current and time to calculate the battery's charged charge.

IP2368 External PIN Setting the initial capacity of the battery cell formula: Battery capacity = R_{FCAP}*0.8 (mAH). Minimum support 2000mAH, maximum support 25000Mah, the capacity set is the capacity of a single string of cells.



Typical battery capacity configuration table:

R17 Resistance Value (Ohms)	Corresponding set cell capacity (mAH)
6.2k	5000mAH
12.4k	10000mAH
18.7k	15000mAH
24.9k	20000mAH
30.9K	25000mAH

Note: The cell capacity in the table refers to the cell capacity of a single battery;

12.8 NTC Functions

The IP2368 integrates the NTC function to detect the battery temperature.The IP2368 generates a constant current source on the NTC pin during operation, and generates a voltage with the external pull-down NTC temperature-sensitive resistor, and the chip determines the current temperature of the battery by internally detecting the voltage on the NTC pin.

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

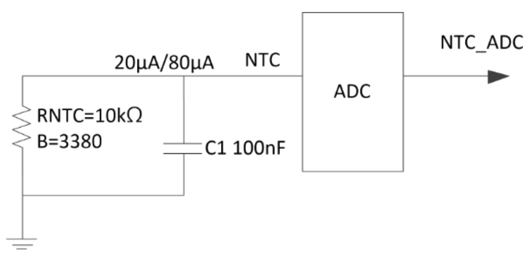


Figure 6 Battery NTC Comparison

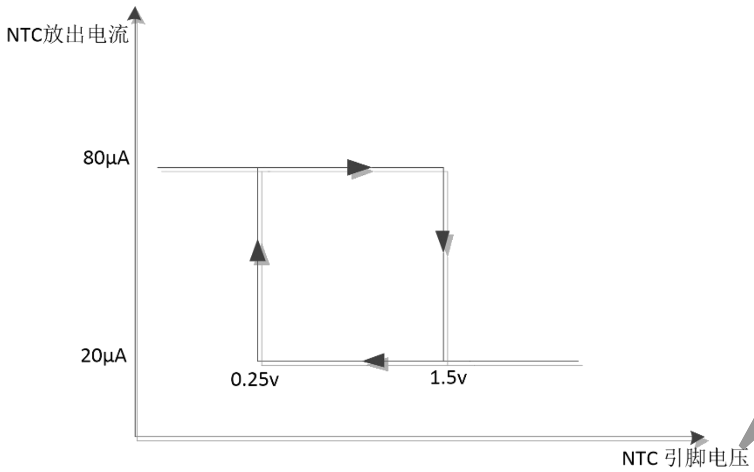


Fig. 7NTC voltage and discharge current relationship

In order to accurately distinguish the temperature of the battery NTC, IP2368 adopts a current-switching NTC detection module. The chip internally detects the current output from the NTC pin and the voltage generated by the external pull-down NTC temperature-sensitive resistor to determine the current battery temperature.

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

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

In the state of charge:

When the NTC output current is 80μA and the voltage at the detected NTC pin is lower than 0.39V, it indicates that the battery temperature is higher than **45°C** and stops the charging function;

When the NTC output current is 20μA and the voltage at the detected NTC pin is higher than 0.55V, it indicates that the battery temperature is lower than **0°C** and the charging function is stopped;

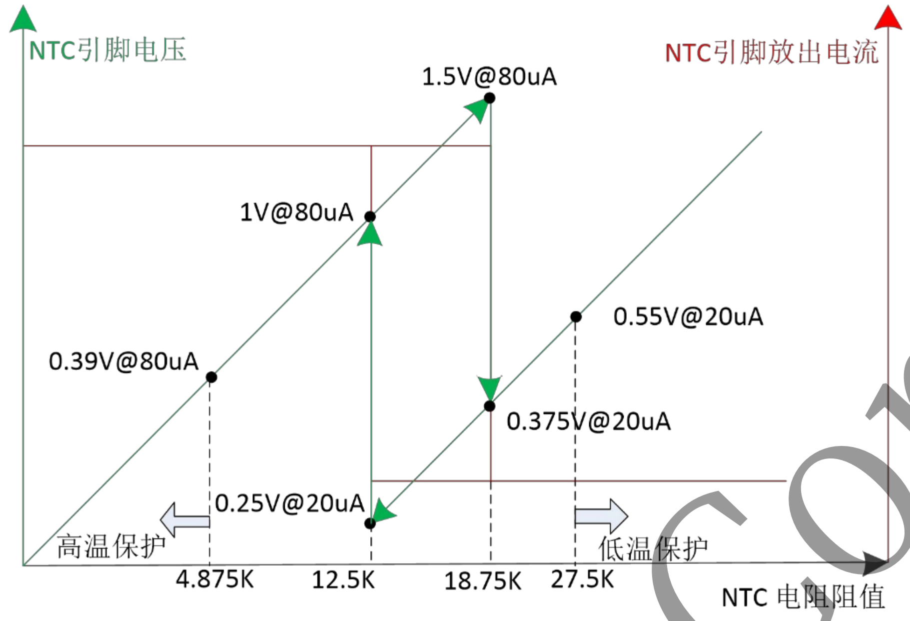


Figure 8NTC Voltage and NTC Resistance Relationships

If the program does not require the NTC function, a 10kΩ resistor should be connected to ground on the NTC pin. If the program does not need NTC function, it is necessary to connect a 10kΩ resistor to the NTC pin to ground, and the NTC pin should not be left floating or directly connected to ground.

12.9 light display

The IP2368 supports a 4, 2, or 1 power indicator light program with the following connections.

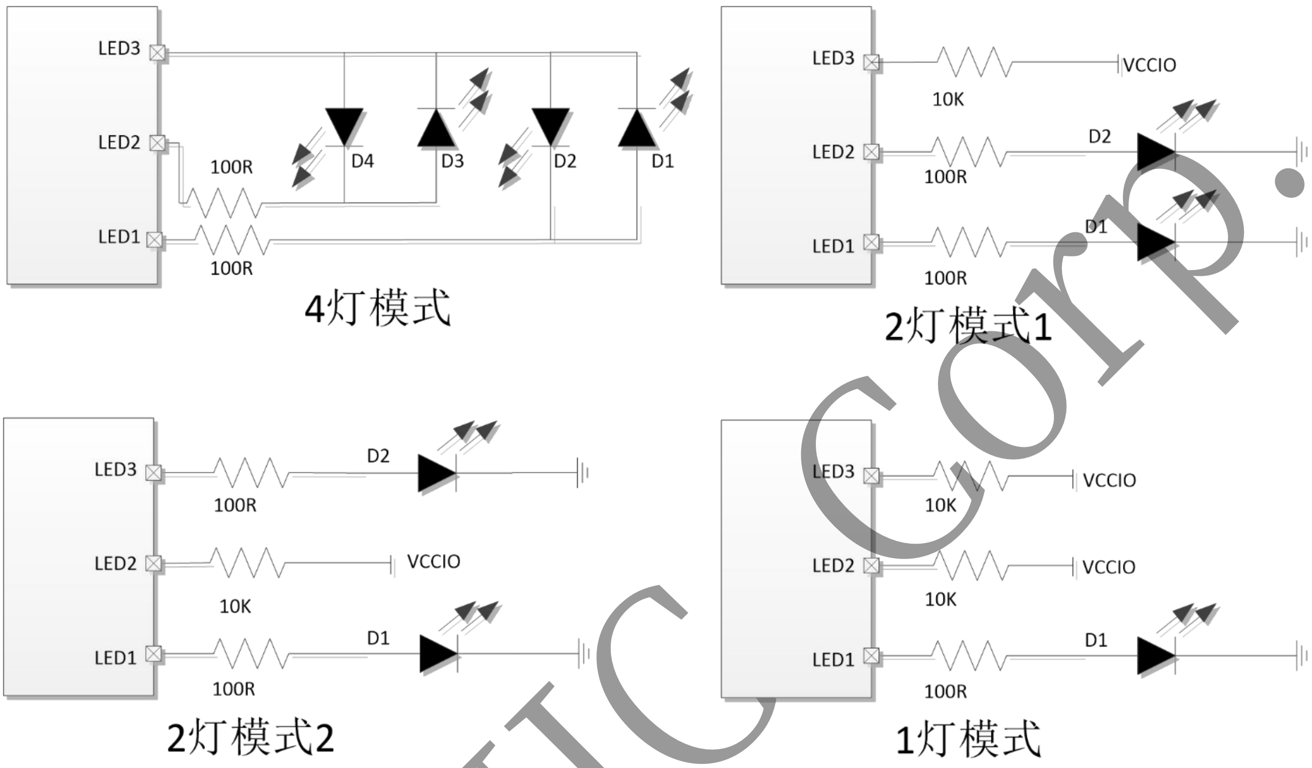


Figure 44, 2, 1 LED connection

4 The lamps are displayed as follows: Normal charging

Electricity C (%)	D1	D2	D3	D4
replenishment	resounding	resounding	resounding	resounding
75%≤C	resounding	resounding	resounding	0.5Hz Flash luminous
50%≤C<75%	resounding	resounding	0.5Hz Flash luminous	go out (of a fire etc)
25%≤C<50%	resounding	0.5Hz Flash luminous	go out (of a fire etc)	go out (of a fire etc)

Normal discharge

Electricity C (%)	D1	D2	D3	D4
75%≤C	vague (of speech) resounding	fire etc) resounding	fire etc) resounding	fire etc) resounding
50%≤C<75%	resounding	resounding	resounding	go out (of a fire etc)

25%≤C<50%	resounding	resounding	go out (of a fire etc)	go out (of a fire etc)
C < 25%	resounding	go out (of a fire etc)	go out (of a fire etc)	go out (of a fire etc)
C=0	Blinks 4 times	go out (of a fire etc)	go out (of a fire etc)	go out (of a fire etc)

Discharge stops after blinking 4 times (200ms on, 200ms off).

2 Lamp Mode 1 is displayed as a two-color lamp: during normal charging

Electricity C (%)	D1	D2
replenishment	go out (of a fire etc)	resounding
66%≤C<100%	go out (of a fire etc)	0.5Hz Flash luminous
33%≤C<66%	0.5Hz vague (of speech)	0.5Hz Flash luminous
C < 33%	0.5Hz vague (of speech)	go out (of a fire etc)

Normal discharge

Electricity C (%)	D1	D2
66%≤C<100%	go out (of a fire etc)	resounding
33%≤C<66%	resounding	resounding
C < 33%	resounding	go out (of a fire etc)
C=0	Blinking 4 substandard	go out (of a fire etc)

Discharge stops after blinking 4 times (200ms on, 200ms off)

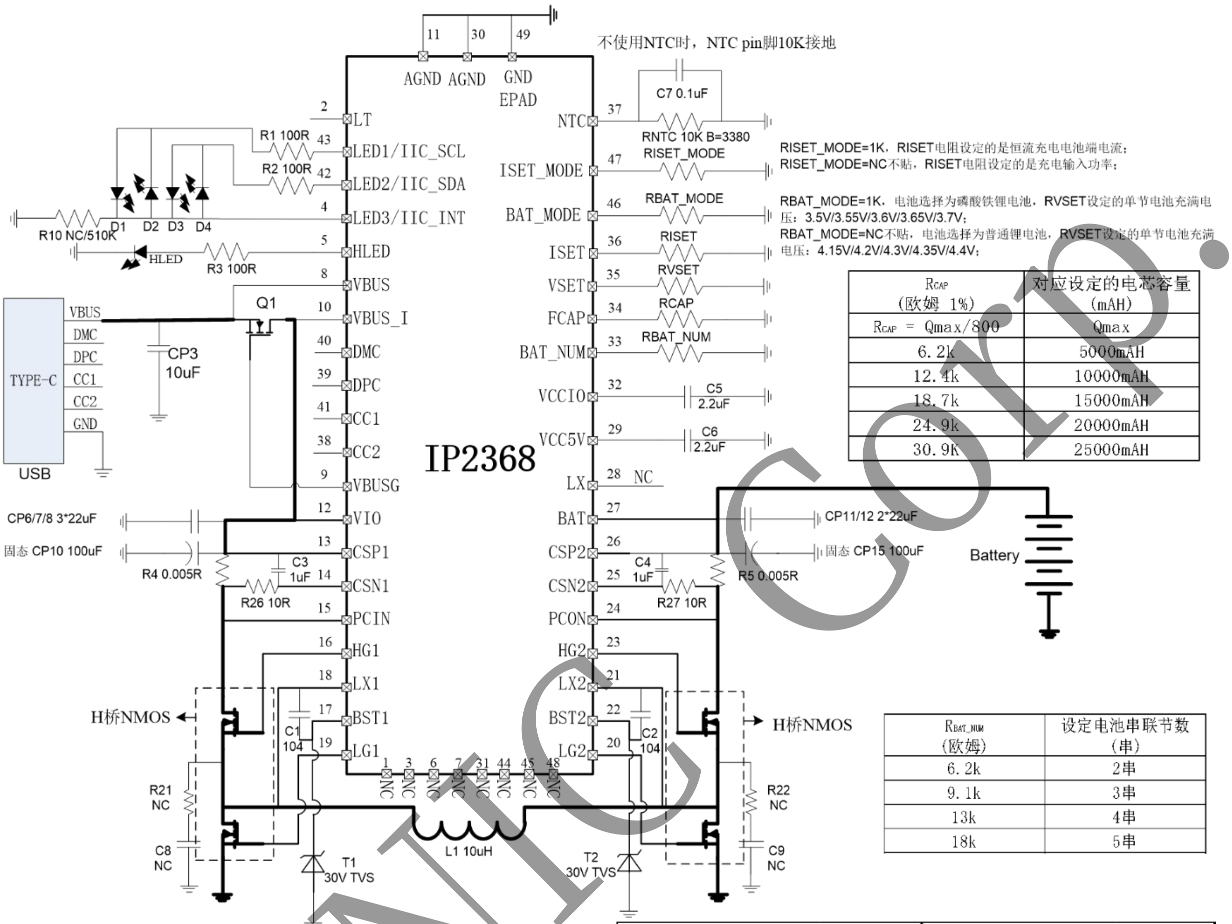
2 Lamp mode 2 is displayed as:
D1 is on and D2 is off during charging, and D1 is off and D2 is on after being fully charged; D1 and D2 flash at the same time during charging abnormality (250ms is on and 250ms is off); D1 is always on during discharging, and D1 flashes 4 times (200ms is on and 200ms is off) after stopping discharging when C=0.

1 The lamp mode is displayed as:

D1 flashes during charging (1s on, 1s off), and D1 is always on when it is fully charged; D1 flashes rapidly during abnormal charging (250ms on, 250ms off), D1 is always on during discharging, and D1 flashes 4 times (200ms on, 200ms off) when C=0 and then stops discharging.

The IP2368 can be customized with other light displays or 188-digit solutions;

13 Application Schematic



R_{CAP}（欧姆 1%） R_{CAP} = Qmax/800	对应设定的电芯容量（mAH） Qmax
6.2k	5000mAH
12.4k	10000mAH
18.7k	15000mAH
24.9k	20000mAH
30.9K	25000mAH

R_{BAT_NUM}（欧姆）	设定电池串联节数（串）
6.2k	2串
9.1k	3串
13k	4串
18k	5串

RBAT_MODE悬空,普通锂电池		RBAT_MODE接地,磷酸铁锂电池	
单节电池充满电压 V_{TRGT}=4000+0.02*R_{VSET} 单位mV step=10mV	R_{VSET}	单节电池充满电压 V_{TRGT}=3500+0.01*R_{VSET} 单位mV step=10mV	R_{VSET}
4.15V	7.5K	3.55V	5K
4.20V	10K	3.60V	10K
4.30V	15K	3.65V	15K
4.35V	17.5K	3.70V	≥20K
4.40V	≥20K		

ISET_MODE悬空 RISET设置恒流最大输入功率		ISET_MODE接地 RISET设置恒流最大电池电流	
充电时的最大输入功率 P_{OCIN}=4*R_{ISET} 单位mW step=1W	R_{ISET}	单节电池充满电压 I_{CHRG}=0.2*R_{ISET} 单位mA step=100mA	R_{ISET}
20W	5K	1A	5K
30W	7.5K	2A	10K
45W	11.2K	2.5A	12.5K
60W	15K	3A	15K
100W	≥25K	5A	≥25K

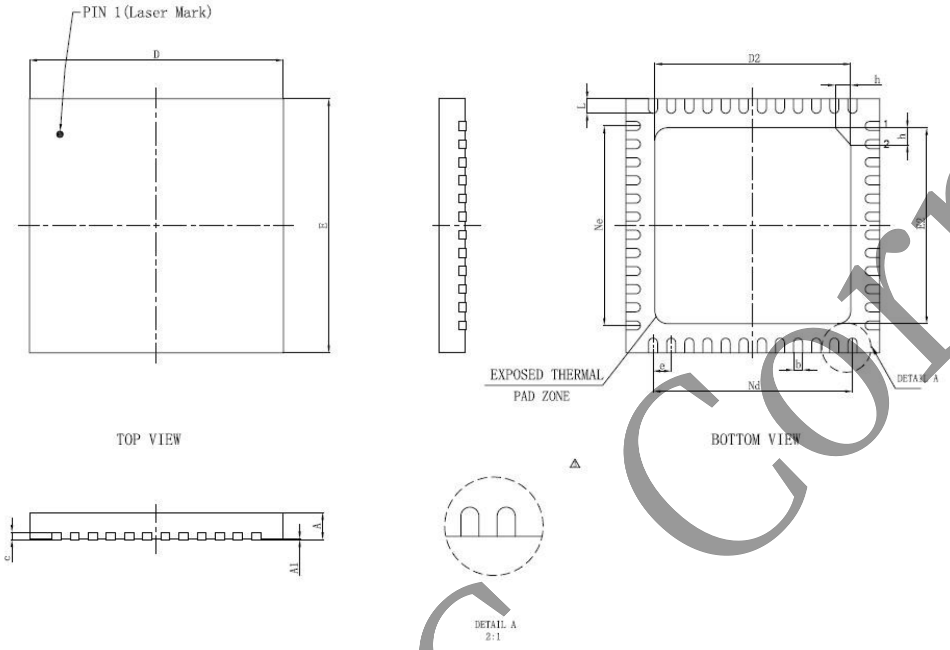
Figure 5 Application schematic

14 BOM table

serial number	Component Name	Model & Specification	placement	dosage	note
1	SMT IC	QFN48 7*7 IP2368	U1	1	
2	chip capacitor	0603 100nF 10% of the total 50V	C1 C2 C7	3	
3	chip capacitor	0603 1uF 10% 16V	C3 C4	2	
4	chip capacitor	0603 2.2uF 10% of the total 16V	C5 C6	2	
5	chip capacitor	0805 10uF 10% 25V	CP3	1	
6	chip capacitor	0805 22uF 10% 25V	CP6 CP7 CP8 CP11 CP12	5	
7	Solid State Capacitors	100uF 35V 10%	CP10 CP15	2	
8	Chip Resistors	1206 0.005R 1%	R4 R5	2	Sampling resistors, requiring high precision Metal Film Resistors for Low Temperature Floating
9	Chip Resistors	0603 100R 5%	R1 R2 R3	3	
10	SMD LEDs	0603LED Lamp	D1 D2 D3 D4 HLED	5	
11	Chip Resistors	0603 10R 1%	R26 R27	2	
12	NTC Thermistors	10K@25℃ B=3380	RNTC	1	NTC Resistor
13	Elevating and lowering piezoelectric inductors	10uH 6A RDC<0.01R	L1	1	
14	Chip MOS Tubes	RU3030M2	Q1	1	Can be omitted
15	USB C Holder	USB C Holder	USB3	1	
16	Chip MOS Tubes	RUH30J51M	Half Bridge Dual NMOS	2	

17	Chip Resistors	0603	RISET RVSET RCAP RBAT_NUM RBAT_MODE RISET_MODE	6	Function selection resistor, patch as required
18	transient suppression diode	30V TVS	T1 T2	2	30V TVS Tube
19			C8 C9 R21 R22		NC

15 Package Information



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.18	0.25	0.30
b1	0.11	0.16	0.21
c	0.18	0.20	0.23
D	6.90	7.0	7.10
D2	5.30	5.40	5.50
e	0.5 BSC		
Ne	5.50BSC		
Nd	5.50BSC		
E	6.90	7.0	7.10
E2	5.30	5.40	5.50
L	0.35	0.40	0.45
h	0.30	0.35	0.40

Figure 6 IP2368 Chip Package Diagram

16 IC Printing Instructions

Figure 7 Silk Screen Printing

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