

support PD3.0 And other fast charging input and output protocols, support 2~6 Cells in series

Integrated buck-boost drive for maximum charging and discharging power 100W power management chip

characteristic

- **Charge and discharge specifications**
 - integrated BUCK-BOOST Buck-boost power NMOS Maximum charging and discharging power 100W
 - Adaptive Charge Current Regulation
 - The full voltage can be set by an external resistor, and the full voltage of a single lithium battery The range that can be set is: 4.1V~4.4V, the full voltage of a single lithium iron phosphate battery can be set as: 3.5V~3.7V
 - External resistance can set the maximum charge and discharge power, the maximum support 100W External resistor selection 2/3/4/5/6 Cell charging in series
- **Fast charging specifications**
 - integrated FCP Input and output fast charging protocol
 - integrated AFC Input and output fast charging protocol
 - integrated SCP Input and output fast charging protocol
 - integrated DRP Try.SRC protocol, PD3.0 Input and output fast charging protocol
 - integration QC2.0/QC3.0/QC3.0+ Output fast charging protocol
- **Power display**
 - built-in 14bit ADC And fuel gauge self-learning fuel gauge, the power display is more uniform
 - Initial battery capacity PIN optional configuration
- **Other functions**
 - 4/2/1 LEDs battery indicator
 - support NTC Battery temperature detection
 - support I2C Function
- **Multiple protection, high reliability**
 - Input overvoltage and undervoltage protection
 - Output overcurrent, short circuit protection
 - Battery overcharge, overdischarge, overcurrent protection
 - I_{CC} over temperature protection
 - rechargeable battery temperature NTC protect
 - ESD 4KV, enter (with CC/DP/DMpin) withstand voltage 30V
- **Package Specifications: 7mm × 7mm 0.5pitch QFN48**

overview

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

IP2368 With high integration and rich functions, only one inductor is needed to realize the synchronous buck-boost function, and only a few peripheral devices are needed in the application, which effectively reduces the size of the overall solution and reduces the BOM cost.

IP2368 support 2/3/4/5/6 Cells in series, the number of cells in series can be selected through an external resistor; IP2368 Support external resistance to choose ordinary lithium battery or lithium iron phosphate battery, external resistance can be set to full voltage, lithium battery full voltage can be set as: 4.15V/4.2V/4.3V/4.35V/4.4V, the full voltage of lithium iron phosphate battery can be set as: 3.5V/3.55V/3.6V/3.65V/3.7V.

IP2368 The synchronous switching charge and discharge system provides up to 100W The charging and discharging power can be set through an external resistor to set the maximum charging and discharging power. IP2368 built-in IC temperature, battery NTC The temperature and input voltage control detection loop can intelligently adjust the charging current according to different power chargers.

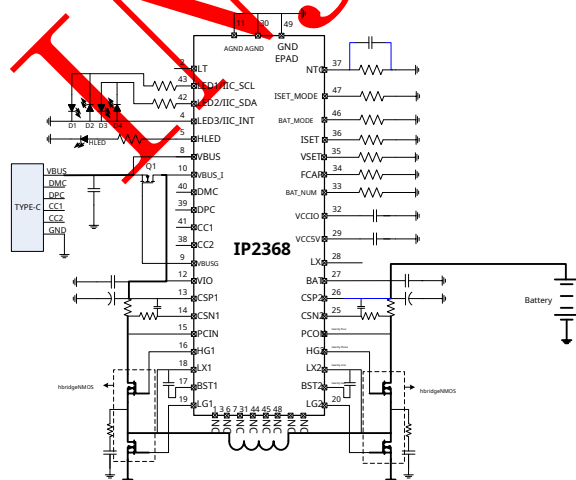
IP2368 built-in 14bit ADC, can accurately measure charging input voltage and current, battery voltage and current. IP2368 Built-in electricity calculation method, can pass I2C Get battery power, charging voltage, charging current and other information.

IP2368 support 41 power indicator light, customized can support 188 Digital Tube.

Application products

- 2~6 Charging and discharging of series lithium battery/lithium iron phosphate battery

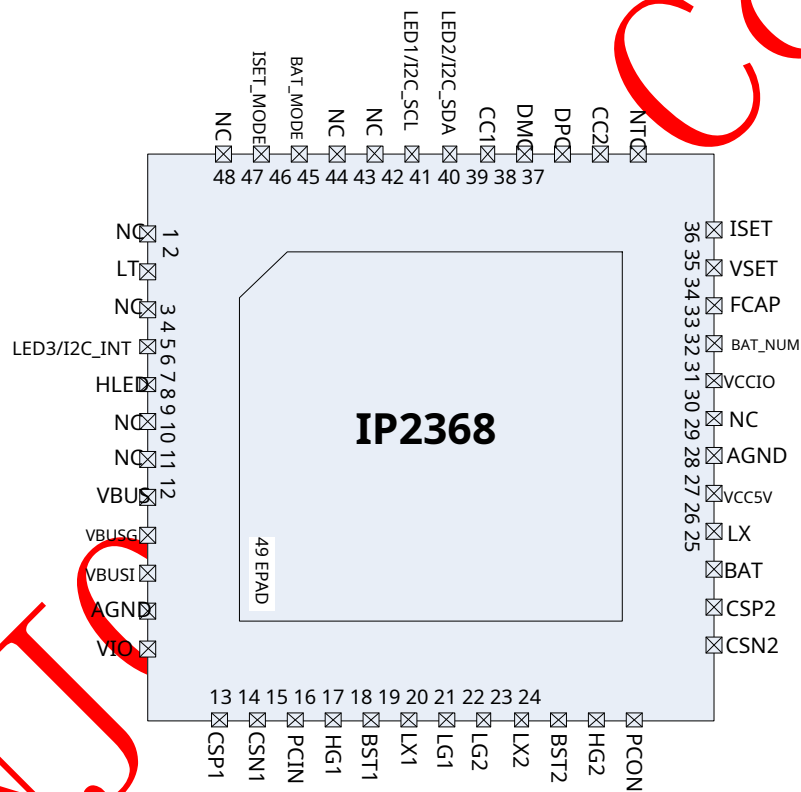
typical application



Description of common customized models

model	Function Description
IP2368_BZ	standardIP2368,support2-6Battery charging
IP2368_COUT	existIP2368On the basis of standard products, addCMouth discharge output function
IP2368_I2C_COUT	existIP2368_COUTBasically, remove the light display and change it toI2Cfunction, available asI2Cslave device

1.pin definition



picture2 IP2368pin diagram

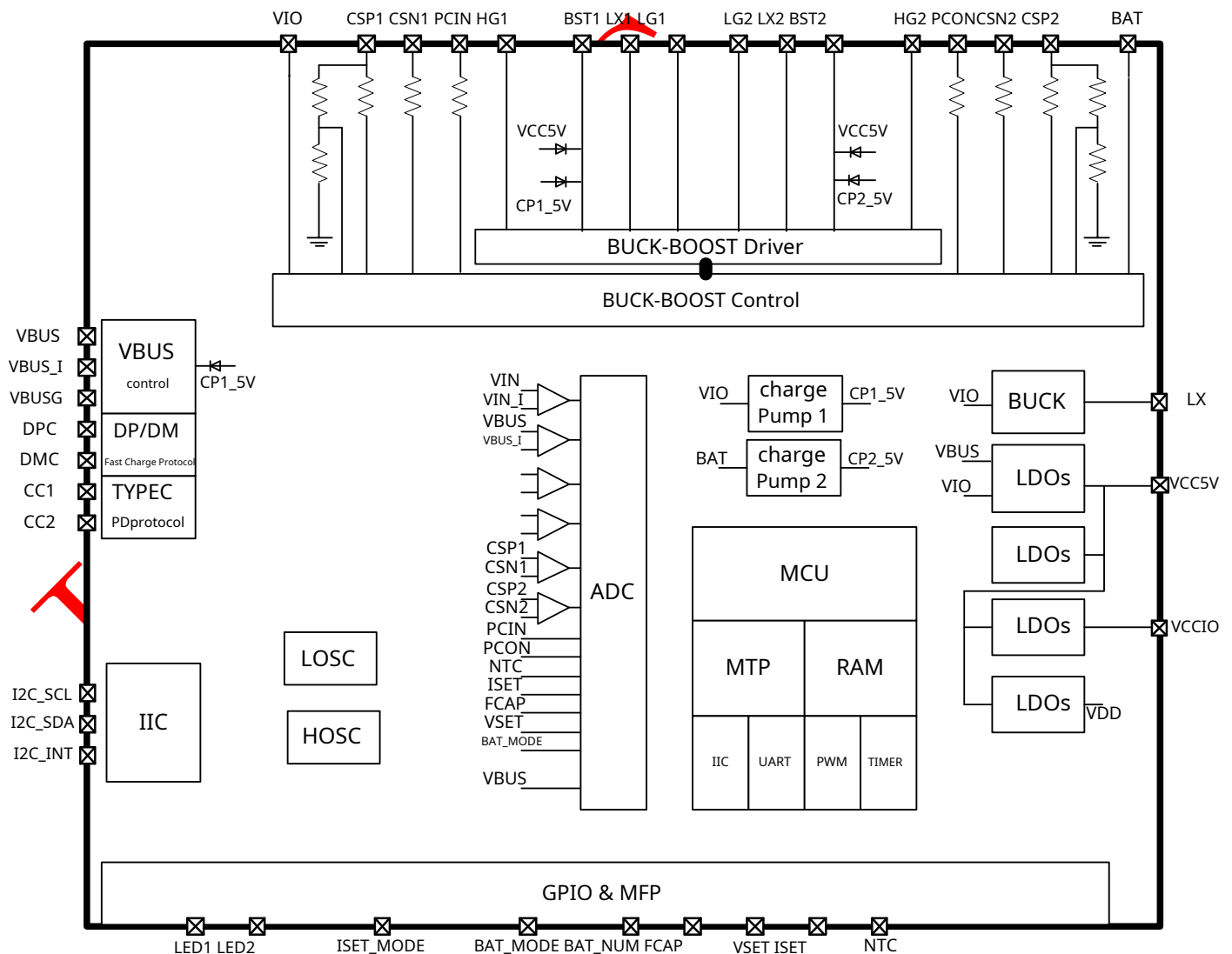
IP2368Pin Description

Pin Num	Pin Name	PINDefinition
1	NC	Undefined pin, keep floating
2	LT	lightingdecode pin
3	NC	Undefined pin, keep floating
4	LED3/I2C_INT	Charging status light display output indicator pin3,I2CThe model isI2C_INTSignal

5	HLED	Fast charging indicator pin, after the fast charging protocol handshake is successful, output high level
6	NC	Undefined pin, keep floating
7	NC	Undefined pin, keep floating
8	VBUS	VBUSinput detection pin
9	VBUSG	VBUSinput pathNMOScontrol pin
10	VBUS_I	VBUSinput Path Current Sense Pin
11	AGND	Simulated
12	VIO	Power input pin
13	CSP1	Input current sampling positive terminal
14	CSN1	Input current sampling negative terminal
15	PCIN	Input peak current sampling pin
16	HG1	hBridge power tube input upper tube control pin
17	BST1	hBridge power tube input bootstrap voltage pin
18	LX1	Input Inductor Connection Pin
19	LG1	hBridge power tube input port down tube control pin
20	LG2	hBridge power tube output battery side lower tube control pin
twenty one	LX2	Battery terminal inductance connection pin
twenty two	BST2	hBridge power tube battery terminal bootstrap voltage pin
twenty three	HG2	hBridge power tube battery side upper tube control pin
twenty four	PCON	Battery terminal peak current sampling pin
25	CSN2	Battery terminal average current sampling negative terminal
26	CSP2	Battery terminal current sampling positive terminal
27	BAT	Battery terminal power supply pin
28	LX	system5Vpowered byBUCKOutput inductor connection point, default floating
29	VCC5V	system5Vpower supply, toICPower supply for internal analog circuits
30	AGND	Simulated
31	NC	Undefined pin, keep floating
32	VCCIO	system3.3Vpower supply, toICInternal digital circuit power supply
33	BAT_NUM	Selection of the number of cells in series, connecting different resistors, you can choose a different number of cells in series
34	FCAP	Battery capacity selection, connect different resistors, you can choose different battery capacities
35	VSET	Battery full voltage selection, connect different resistors, you can choose different rechargeable battery voltage
36	ISET	Constant current charging power or charging current setting
37	NTC	NTCResistance detection pin
38	CC2	USB-CPort detection and fast charge communication pinCC2
39	DPC	USB-CPort fast charging intelligent identificationDP
40	DMC	USB-CPort fast charging intelligent identificationDM

41	CC1	USB-CPort detection and fast charge communication pinCC1
42	LED2/I2C_SDA	Charging status light display output indicator pin2,I2CThe model isI2C_SDASignal
43	LED1/I2C_SCL	Charging status light display output indicator pin1,I2CThe model isI2C_SCLSignal
44	NC	Undefined pin, keep floating
45	NC	Undefined pin, keep floating
46	BAT_MODE	Battery type selection, choose lithium iron phosphate battery for grounding, choose ordinary lithium battery for floating or connecting high
47	ISET_MODE	ISETCurrent setting mode selection, ground selectionISETSet the battery terminal constant current charging, floating or connected to high selectionISETSet charging input power
48	NC	Undefined pin, keep floating
49 (EPAD)	GND	system ground and thermal ground, need to be kept withGNDgood contact

2.Chip Internal Block Diagram



picture3Chip Internal Block Diagram

INJOINIC Corp

3.Limit parameter

parameter	symbol	value	unit
Port voltage range	VBAT/VBUS	- 0.3 ~ 35	V
Protocol interface voltage range	DPC/DMC/CC1/CC2	- 0.3 ~ 30	V
numberGPIOsvoltage range	LED/GPIO	- 0.3 ~ 8	V
Junction temperature range	T _J	- 40 ~ 125	°C
storage temperature range	T _{stg}	- 60 ~ 150	°C
Thermal Resistance (Junction Temperature to Ambient)	θ _{JA}	30	°C/W
Mannequin (HBM)	ESD	4	KV

*Stresses above those listed in the Absolute Maximum Ratings section may cause permanent damage to the device. Under any Absolute Maximum Ratings conditions

Excessive exposure time may affect the reliability and service life of the device

4.Recommended working conditions

parameter	symbol	minimum value	typical value	maximum value	unit
Input voltage	VBUS	4.5		25	V
battery voltage	VBAT			28	V
Working temperature	T _A	- 40		85	°C

*Device performance is not guaranteed beyond these operating conditions.

5.electrical characteristics

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

parameter	symbol	Test Conditions		minimum value	typical value	maximum value	unit
charging system							
Input voltage	V _{BUS}			4.5	5/9/12/15/20	25	V
Input overvoltage voltage	V _{BUS}	rising voltage				25	V
Charging constant voltage	V _{TRGT}	BAT_MODEfloating, choose Ordinary lithium battery V _{TRGT} =4000+0.02*R _{VSET} (unitmV) step=10mV	R _{VSET} = 7.5K	N*4.11	N*4.15	N*4.19	V
			R _{VSET} = 10K	N*4.16	N*4.20	N*4.24	V
			R _{VSET} = 15K	N*4.26	N*4.30	N*4.34	V
			R _{VSET} = 17.5K	N*4.31	N*4.35	N*4.39	V
			R _{VSET} ≥20K	N*4.36	N*4.40	N*4.44	V
		BAT_MODEgrounding, choose Lithium iron phosphate battery V _{TRGT} =3500+0.01*R _{VSET} (unitmV)step=10mV	R _{VSET} = 5K	N*3.51	N*3.55	N*3.59	V
			R _{VSET} = 10K	N*3.56	N*3.60	N*3.64	V
			R _{VSET} = 15K	N*3.61	N*3.65	N*3.69	V
			R _{VSET} ≥20K	N*3.66	N*3.70	N*3.74	V
charging power or flow	P _{CCIN} OR I _{CHRG}	ISET_MODEdangling, chooseISETSet constant current charging The maximum input power when powering on P _{CCIN} =4*R _{ISET} (unitmW)step=1W	R _{ISET} = 5K		20		W
			R _{ISET} = 7.5K		30		W
			R _{ISET} = 11.2K		45		W
			R _{ISET} = 15K		60		W
			R _{ISET} ≥25K		100		W
		ISET_MODEground, chooseISETSet constant current charging Maximum battery current when charging I _{CHRG} =0.2*R _{ISET} (unitmA) step=100mA	R _{ISET} = 5K		1		A
			R _{ISET} = 10K		2		A
			R _{ISET} = 12.5K		2.5		A
			R _{ISET} = 15K		3		A
			R _{ISET} ≥2 5K		5		A
peak current	I _{L PK}	Inductor Peak Current Limit				8	A
Trickle charge current	I _{TRKL}	VIN=5V, VBAT<2.5V		30	50	70	mA
		VIN=5V, 2.5V<=VBAT<VTRKL		100	200	300	mA
Trickle cut-off voltage	V _{TRKL}	BAT_MODEfootNCSuspended, choose ordinary lithium battery, the number of battery cells isN		N*2.9	N*3	N*3.1	V
		BAT_MODEPin ground, choose lithium iron phosphate battery Lithium battery, the number of battery cells isN		N*2.4	N*2.5	N*2.6	V
Charging stop charging current	I _{STOP}				100		mA
recharge threshold	V _{RCH}	The number of batteries isN			V _{TRGT} - N*0.1		V

Charging deadline	T_{END}		45	48	51	hours
discharge system						
Battery working voltage	V_{BAT}	The number of batteries is N	N*2.75		N*4.5	V
switch working battery Input Current	I_{BAT}	$V_{BAT}=4*3.7V$, $V_{OUT}=5.0V$, $f_s=250kHz$, $I_{out}=0mA$	3	7		mA
DCThe 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}	$V_{BAT}=4*3.7V$, $V_{OUT}=5.0V$, $f_s=250kHz$, $I_{out}=1A$		120		mV
		$V_{BAT}=4*3.7V$, $V_{OUT}=9.0V$, $f_s=250kHz$, $I_{out}=1A$		135		mV
		$V_{BAT}=4*3.7V$, $V_{OUT}=12V$, $f_s=250kHz$, $I_{out}=1A$		370		mV
discharge system max. Output Power	P_{max}	PDunder the agreement, different P_{MAX} Resistor values correspond to different P_{max}	20		100	W
Discharge system efficiency	η_{out}	$V_{BAT}=8V$, $V_{out}=5V$, $I_{out}=2A$		94.69		%
		$V_{BAT}=8V$, $V_{out}=9V$, $I_{out}=2A$		95.36		%
		$V_{BAT}=8V$, $V_{out}=12V$, $I_{out}=2A$		95.86		%
		$V_{BAT}=15V$, $V_{out}=5V$, $I_{out}=2A$		91.55		%
		$V_{BAT}=15V$, $V_{out}=9V$, $I_{out}=2A$		95.05		%
		$V_{BAT}=15V$, $V_{out}=12V$, $I_{out}=2A$		95.37		%
discharge system overcurrent Shutdown current	$I_{close up}$	$V_{BAT}=N*3.7V$, Multi-port output 5V	4.1	4.4	4.7	A
		$V_{BAT}=N*3.7V$, single port output 5V	3.1	3.4	3.8	A
		$V_{BAT}=N*3.7V$, single port output 9V, No PD state	2.7	3	3.3	A

		VBAT = N *3.7V,single port output12V,NoPD state	2	2.2	2.5	A
		VBAT = N *3.7V,single port outputPDstate		PDO* 1.1		A
Load overcurrent detection time	T _{UVD}	The output voltage remains below the2.4V		30		ms
Load short detection time	T _{OCD}	The output voltage remains below the2.2V		40		us
Control System						
On-off level	fs	Discharge switching frequency		250		kHz
		Charging switching frequency		250		kHz
VCCIOoutput Voltage	V _{CCIO}		3.15	3.3	3.45	V
Battery terminal standby power flow	I _{STB}	VBAT=14.8V, the average current after the button is turned off		180		uA
LDOsoutput power flow	I _{LDOs}		25	30	35	mA
ledlighting driver electric current	I _{WLED}		10	15	20	mA
leddisplay driver electric current	I _{L1} I _{L2} I _{L3}	voltage drop10%	5	7	9	mA
thermal shutdown temperature	T _{OTP}	rise in temperature	110	125	140	°C
Thermal shutdown temperature late stagnant	ΔT _{OTP}			40		°C

6.Functional description

charging process

IP2368It has a constant current and constant voltage lithium battery charging management system that supports a synchronous switch structure. IP2368Using switching charging technology, the switching frequency250kHz.

IP2368Different battery types, full voltage and charging current can be set through external resistors, which can support2/3/4/5/6Charging lithium iron phosphate or lithium batteries in series, the maximum charging current can reach5Aor100Wcharging input, charging efficiency up to96%;

IP2368Support trickle-constant current-constant voltage charging process:

When the battery voltage $V_{BAT} \leq 2.5V$, for small current trickle charging, the battery charging current100mAabout;

When the battery voltage $2.5V < V_{BAT} \leq V_{TRKL}$, for trickle charging, the battery charging current200mAabout;BAT_MODEWhen floating, the trickle charge cut-off voltage V_{TRKL} forN*3V;BAT_MODEWhen grounded, the trickle charge cut-off voltage V_{TRKL} forN*2.5V;

When the battery voltage $V_{TRKL} < V_{BAT} < V_{TRGT}$, it is constant current charging, and the charging current charges the battery according to the set constant current charging current; full voltage V_{TRGT} and constant charge current can be accessed by an external R_{VSET} and R_{ISET} to set;

When the battery voltage $V_{BAT} = V_{TRGT}$, when the battery voltage rises to close to the full voltage, the charging current will drop slowly and enter constant voltage charging; after entering constant voltage charging, when the battery charging current is less than I_{STOP} (100mA) and the battery voltage is close to the constant voltage, stop charging, and turn to fully charged state.

After full charging and stop charging, it will continue to detect the battery voltage, when the battery voltage is lower than $V_{BAT} < V_{TRGT} - N*0.1V$ After that, charging will restart;

IP2368Different trickle charge cut-off voltages can be customized V_{TRKL} , can also be customized0VBattery prohibition charging function; IP2368_COUTBy default, after connecting the battery for the first time, it needs to be charged and activated before it can be discharged externally; it can be customized to remove the charging activation function;

Type_C PD

IP2368IntegratedUSB Type_CInput and output identification interfaces, automatic switching of built-in pull-up and pull-down resistors, automatic identification of charging and discharging properties of inserted devices. withTry. SRC function, when connected to the other party asDRPWhen using other devices, you can give priority to charging the other party.

IP2368supportPD2.0/PD3.0Bi-directional input/output protocol. maximum support100Wpower output, input support5V,9V,12V,15V,20V Voltage range, output support5V,9V,12V,15V,20Vvoltage range.IP2368customization can be achievedPPSoutput function;

Fast charging function

IP2368Supports fast charging forms of various specifications:QC2.0/QC3.0/QC3+,FCP,AFC,SCP,Apple. Charging the battery input can supportFCP,AFCWaiting for fast charge input, due toFCP,AFCis throughDP/DMFor fast charging handshake request, so when other fast charging protocols are addedICis no longer supportedFCP,AFCfast charge.

IP2368Integrated withAFC/FCP/PD2.0/PD3.0Enter the fast charging protocol, you can passTypeCVerbalDPC/DMC/CC1/CC2To apply for fast charging voltage to the fast charging adapter, it will automatically adjust the charging current to adapt to adapters with different load capacities.

When using a normal battery without fast charging5WWhen the charger or power supply is used for charging, the maximum charging current at the input terminal will be set to3A; When using only HuaweiFCPor SamsungAFCfast charge protocol, but noPDWhen charging with a fast-charging charger, the maximum charging power at the input terminal will be limited to18W(9V/2A,12V/1.5A);

when used PD When the fast charging adapter is charging, it will press the received PD package to limit the maximum input charging power when the received PD package power less than ISET. When the power required for charging is set, it will actively reduce the charging current so that the maximum power at the input end is less than or equal to that given by the adapter. PD broadcast power;

For example 1: ISET_MODE = dangle, $R_{SET} = 15K$, set the maximum input power for constant current charging to 60W, if a 30W PD adapter is used to charge IP2368, the input charging current will be limited to 30W; only when a 60W or above PD adapter is used to charge IP2368, the input power I_t will reach the set 60W;

For example 2: ISET_MODE = ground, $R_{BAT_NUM} = 9.1K$, 3 string battery charging, $R_{SET} = 15K$, set the maximum charging current of the battery terminal to 3A, use a 30W PD adapter to charge the IP2368, and successfully enter the PD fast charge, regardless of the charging conversion efficiency, at the battery voltage V_{BAT} . When $< 10V$, the charging power is less than 30W, which does not reach the maximum output power of the adapter, and the battery charging current can guarantee 3A constant current charging; when the battery voltage V_{BAT} after $> 10V$, since the power required for charging is greater than 30W, exceeding the maximum output power of the PD adapter, the battery charging current will be automatically reduced to maintain the input power at 30W;

If the charging input is a fixed voltage input instead of an adapter, you can use a customized model of IP2368_NA;

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 ensure that the charging input power load capacity is greater than the set charging maximum power;

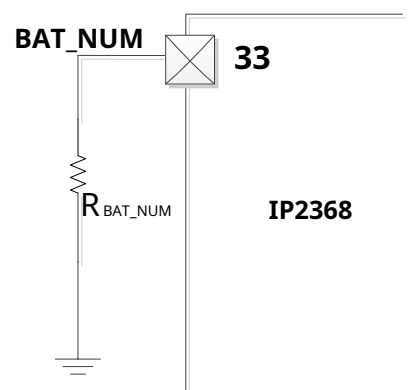
Automatic detection when the battery is discharged externally DP, DM. The fast charging timing on the pin, smart identification of mobile phone type, can support QC2.0/QC3.0/QC3+, FCP, AFC, SCP Protocol mobile phones, as well as Apple mobile phones 2.4A model, BC12 ordinary android cell phone 1A model.

Setting the number of battery cells in series

IP2368 can support 2/3/4/5/6 Charging of string batteries;

IP2368 accessible BAT_NUM . Different resistors are connected to the pins to select and set the number of batteries in series; BAT_NUM pin external resistor R_{BAT_NUM} . The relationship with the number of batteries connected in series is as follows:

R_{BAT_NUM} (ohm)	Set the number of battery cells in series (string)
6.2k	2 skewers
9.1k	3 skewers
13k	4 skewers
18k	5 skewers
27k	6 skewers

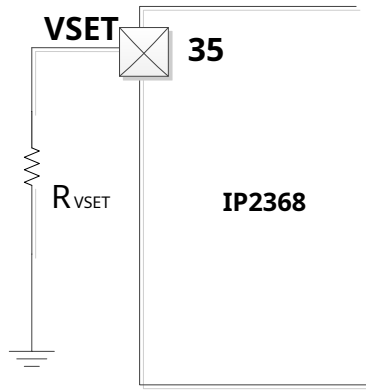


when R_{BAT_NUM} resistance greater than 33K, will detect that R_{BAT_NUM} The resistance is open circuit, in order to ensure the safety of charging, the charging status indicator will give an abnormal alarm;

Battery type and full voltage setting

IP2368 of BAT_MODE is floating, choose ordinary lithium battery, single battery is full of voltage range 4.1V~4.4V; BAT_MODE foot connection 1K Resistor to ground, choose lithium iron phosphate battery, single battery is full of voltage range 3.5V~3.7V;

VSET Pin-to-ground resistance R_{VSET} The relationship with the set full voltage is as follows:



RBA T_M ODE is suspended, ordinary lithium battery		RBA T_M ODE is grounded, and the single-cell lithium iron phosphate battery is fully charged	
single battery is full of voltage $V_{TRGT}=4000+0.02 \cdot R_{VSET}$ Unit mV step=10mV	R_{VSET}	phosphate battery is fully charged $V_{TRGT}=3500+0.01 \cdot R_{VSET}$ Unit 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	$\geq 20K$
4.40V	$\geq 20K$		

Notice:

- 1, R_{VSET} The set single-cell battery is fully charged, and the actual BAT The output voltage is also multiplied by the number of battery cells;
- 2, single battery full voltage voltage setting step is 10mV, to ensure accuracy, R_{VSET} to use 1% precision resistors;
- 3, when R_{VSET} resistance greater than 33K, will detect that R_{VSET} The resistor is open circuit. In order to ensure the safety of charging, the charging status indicator will report abnormally.

police;

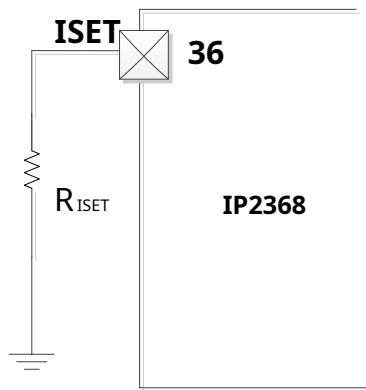
Charging current setting

IP2368 able to pass ISET pin to set the charging current;

ISET_MODE When the feet are in the air, ISET The pin sets the maximum input power during charging. During constant current charging, the input voltage and current remain unchanged. As the battery voltage rises, the charging current at the battery terminal will decrease;

ISET_MODE foot connection 1K resistor to ground, ISET The pin sets the charging current of the battery terminal. When the input load capacity is sufficient, the charging current of the battery terminal remains constant. As the battery voltage rises, the current and power of the input terminal will increase;

ISET foot resistance R_{ISET} The relationship with the set input and output power or charging current is as follows:



ISET_M ODE floating R _{ISET} sets the constant current maximum input power		ISET_MODE GND R _{ISET} sets constant current maximum battery current	
Maximum input power when charging $P_{CCIN}=4 \times R_{ISET}$ Unit mW step=1W	R _{ISET}	Single battery full voltage $I_{CHRG}=0.2 \times R_{ISET}$ Unit 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

Notice:

- When setting the input power, the minimum step is 1W, the maximum input power is 100W; When setting the battery current, the minimum step is 100mA, The maximum input current is 5A; R_{ISET} more than the 25K After, it will be set to the maximum 100W or 5A Charge;
- when R_{ISET} resistance greater than 33K, will detect that R_{ISET} The resistor is open circuit. In order to ensure the safety of charging, the charging status indicator will report abnormally. police;
- 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 R_{ISET} The set charging power will automatically reduce the charging current;
- If the input power is not the first 3Square charger, but a fixed input power supply, you can use the customized model of P2368_NA, the customized The model will not automatically reduce the charging current according to the power supply capacity of the charger;

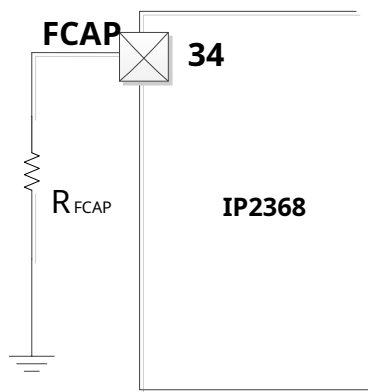
IP2368_COUT support Cport discharge output function, the discharge output of the PDO, also available via ISET pin to set, the calculation formula of output power setting is the same as that of input power setting; when the set power is greater than 60W After, it is not recognized E-MARK When using a cable, the output broadcast capability will be limited to a maximum of 60W, output PDO: 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/3A. in recognition of E-MARK cable (additional E-MARK circuit) when the output broadcasting capability can reach the maximum 100W, output PDO: 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/5A;

fuel gauge

IP2368 Built-in fuel gauge function for accurate battery power calculation.

IP2368 It supports externally setting the capacity of the battery cell, and uses the integral of the battery terminal current and time to calculate the charged battery capacity. IP2368

external PIN The formula for setting the initial capacity of the battery cell: battery capacity = R_{FCAP} * 0.8 (mAh). minimum support 2000mAh, the maximum supported 25000Mah, the set capacity is the capacity of a single string of batteries.



Typical battery capacity configuration table:

R17Resistance value (ohm)	Corresponding to the 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;

NTCFunction

IP2368integratedNTCfunction to detect battery temperature.IP2368after power onNTC PINoutput at high temperature80uAcurrent at low temperature output20uA current, through the externalNTCresistance to generate voltage,ICinternal inspectionNTC PINPin voltage to judge the current battery temperature.

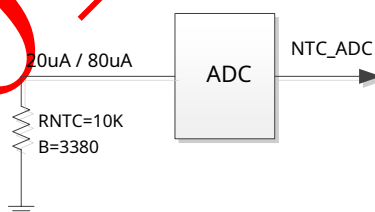


Figure 12 Battery NTC comparison

In charging state:NTCtemperature below0Spend(0.55V) to stop charging,0~45normal charging between degrees, the temperature exceeds45Spend(0.39V) to stop charging.

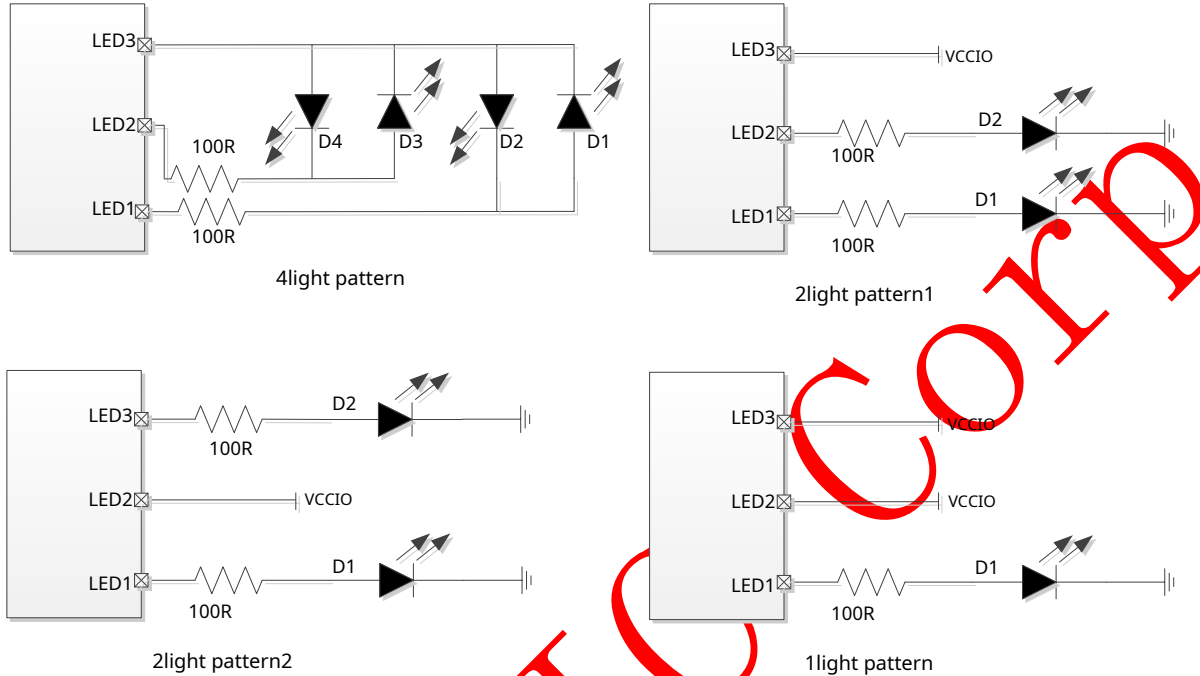
In discharge state: the temperature is lower than -20Spend(1.39V), stop discharging,-20degree to60normal discharge between degrees, higher than60Spend(0.24V) to stop discharging;

existNTCAfter abnormal temperature is detected, the recovery temperature is the protection temperature ± 5 Spend. The above brackets are corresponding to the temperatureNTCPin voltage, calculated as:NTCThe current released by the pin * the temperatureNTCResistor resistance.

The above temperature range refers toNTCThe resistance parameter is10K@25°CB=3380, there are differences in other models and need to be adjusted. If the program does not requireNTC,need to be inNTCpin to ground10kResistors cannot be floating or grounded directly.

light display

IP2368support4,2,1The solution of the battery indicator light, the connection method is as follows.



4, 2, 1 LED connection method

4The lights are displayed as:

During normal charging

electricityC(%)	D1	D2	D3	D4
full	Bright	Bright	Bright	Bright
$75\% \leq C$	Bright	Bright	Bright	0.5Hzflashing
$50\% \leq C < 75\%$	Bright	Bright	0.5Hzflashing	off
$25\% \leq C < 50\%$	Bright	0.5Hzflashing	off	off
$C < 25\%$	0.5Hzflashing	off	off	off

2light pattern1The display method is a two-color light: When

charging normally

electricityC(%)	D1	D2
full	off	Bright
$66\% \leq C < 100\%$	off	0.5Hzflashing
$33\% \leq C < 66\%$	0.5Hzflashing	0.5Hzflashing
$C < 33\%$	0.5Hzflashing	off

2light pattern2is displayed as:

chargingD1BrightD2off, after fullD1offD2On; Abnormal chargingD1andD2Blinking at the same time (250msBright250msoff)

1The light mode is displayed as:

chargingD1Blinking (1s on and 1s off), after fully charged, D1 is always on; abnormal chargingD1flashing rapidly (250msBright250msoff)

HLEDThe pin indicates the fast charge state, when it is input or output fast charge,HLEDThe pin outputs high level, otherwise it outputs low level;

IP2368Other lights can be customized or188Nixie tube solution;

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7.Application Schematic

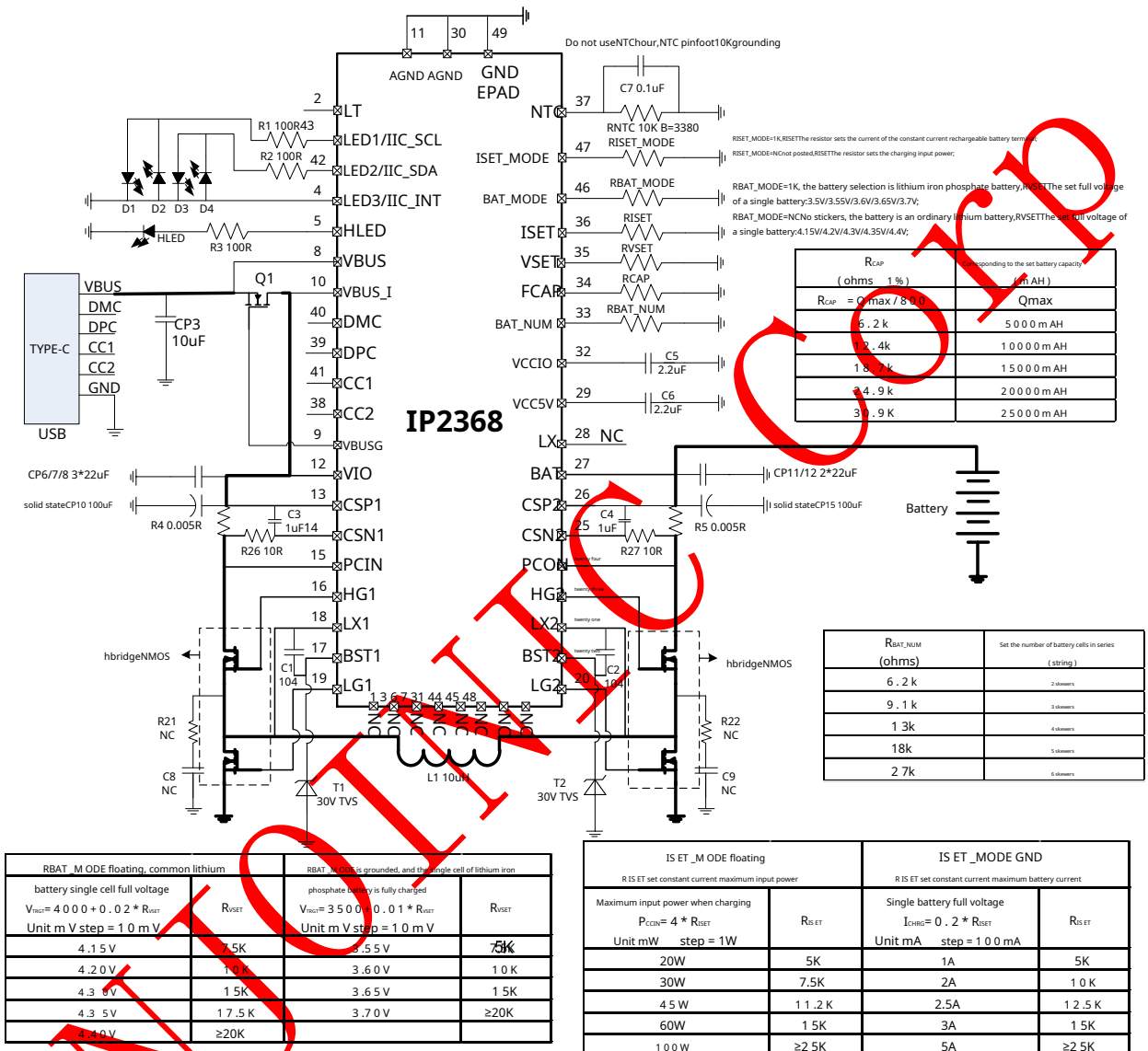


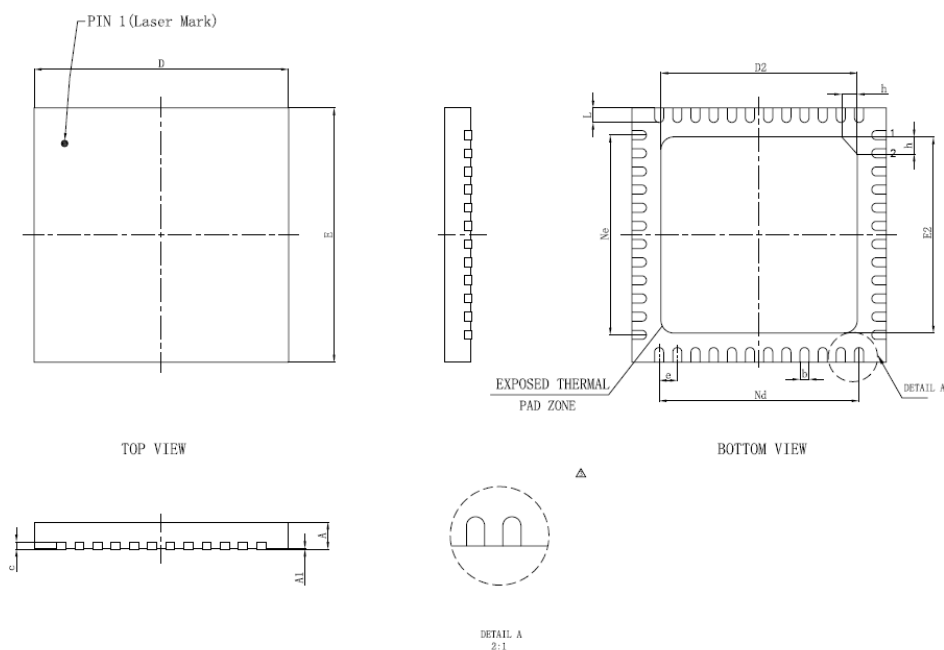
Figure 13 Application schematic diagram

8. BOMsurface

serial number	Component name	Model & Specification	Location	Dosage	Remark
1	patchIC	QFN48 7*7 IP2368	U1	1	
2	Chip capacitors	0603 100nF 10% 50V	C1 C2 C7	3	
3	Chip capacitors	0603 1uF 10% 16V	C3 C4	2	
4	Chip capacitors	0603 2.2uF 10% 16V	C5 C6	2	
5	Chip capacitors	0805 10uF 10% 25V	CP3	1	
6	Chip capacitors	0805 22uF 10% 25V	CP6 CP7 CP8 CP11 CP12	5	
7	Solid Capacitor	100uF 35V 10%	CP10 CP15	2	
8	Chip Resistor	1206 0.005R 1%	R4 R5	2	Sampling resistance, requiring high precision Metal film resistors with low temperature drift
9	Chip Resistor	0603 100R 5%	R1 R2 R3	3	
10	patchled	0603 LEDlamp	D1 D2 D3 D4 HLED	5	
11	Chip Resistor	0603 10R 1%	R26 R27	2	
12	NTCThermistor	10K@25°C B=3380	RNTC	1	NTC resistor
13	Buck-Boost Inductor	10uH 6A Rdc<0.01R	L1	1	
14	patchMOSTube	RU3030M2	Q1	1	can be omitted
15	USB-CSeat	USB-CSeat	USB3	1	
16	patchMOSTube	RU30J30M	half bridge doubleNMOS	2	
17	Chip Resistor	0603	R1SET RVSET RCAP RBAT_NUM RBAT_MODE R1SET_MODE	6	Function selection resistor, according to actual needs Ask for patch
18	TVS Diode	30V TVS	T1 T2	2	30V TVSTube
19			C8 C9 R21 R22		NC

9.Package information

chip packaging



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

10. ICsPrinting instructions



Figure 15 silk screen image

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