Support 3-way Type-C、PD3.0 and Fast Charge protocol Power Bank SOC

1. Features

- **Support multiple ports simultaneously**
- ✧ Output Connector: Optional USB-C/USB-A×1, USB-A×1
- ✧ In/Out Connector: USB C×2
- **Fast charge**
- ✧ Every port support fast charge
  - —Input/output fast charge protocol: FCP, AFC, PD
  - —Output fast charge protocol: QC2.0/QC3.0, SCP
- ✧ Integrated USB-C DRP protocol, support input and output fast charge
- ✧ PDO：5V@3.0A、9V@2.22A、12V@1.67A、5V~11V@2A
- ✧ Support BC1.2 / Apple / Samsung
- ✧ Integrate communication of lightning input
- **Integrated USB PD2.0 / PD3.0 protocol**
- ✧ PD input fast charge protocol:
  Support PD2.0, PD3.0
  - Support 5V, 9V, 12V voltage input
- ✧ PD output fast charge protocol:
  Support PD2.0, PD3.0, PPS
  - Support 5V, 9V, 12V voltage output
  - PPS support 5~11V adjustable voltage with 20mV / Step
- ✧ Integrated Physical Layer Protocol (PHY)
  - Supports BMC, hardware CRC, Hard Reset
- **Charger**
- ✧ Maximum charging power: 20W
- ✧ Charging current adaptive:
  -Undervoltage loop: adaptive charging current according to input voltage
  -Intelligent recognition of charging protocols: 20W max input for PD protocols, 18W max input for non-PD protocols.
- ✧ Support 4.20V, 4.30V, 4.35V, 4.40V NMC battery and 3.55V, 3.60V, 3.65V, 3.70V LFP battery
- **Boost**
- ✧ Output current:
  5V@3.1A、9V@2.22A、12V@1.67A、10V@2.25A
- ✧ Synchronous switch discharge efficiency ≥95%(Condition: 5V@2A)
- ✧ Support line loss compensation
- **Power display**
- ✧ Integrated 14bit ADC to support high-precision power meters
- ✧ Support 1/2/3/4 LED power display, intelligent identification of the number of LED power display lights
- ✧ Support 88/188 nixie tube
- **Multiple pin selection functions**
- ✧ Support pin selection of battery capacity and voltage
- ✧ Supports pin selection of LED or digital tube mode
- ✧ Supports pin selection of output normally open 2-hour mode
- ✧ Support pin selection for internal intelligent temperature loop threshold of chip
- **Other functions**
- ✧ Supports wireless charging mode
- ✧ Supports LFP battery
- ✧ Support auto detect of plug in and out
- ✧ Intelligent identification load, light load automatically enter the standby
- ✧ Fast charge status indicator
- ✧ Support Battery NTC
- ✧ Support I2C interface
- ✧ Integrated torch-light driver
- **Multiple protection,high reliability**
- ✧ Input overvoltage and undervoltage protection
- ✧ Output overcurrent,overvoltage and short circuit protection
- ✧ Battery overcharge,over discharge and overcurrent protection
- ✧ Over temperature protection
- ✧ Input / Output battery temperature protection
- ✧ 4kV ESD,input voltage up to 20V (including CC pins)
- **Low BOM cost**
- ✧ Integrated switch power MOSFET
- ✧ Single inductor for charging and discharging
- **Package size: QFN48 (6mm × 6mm, 0.4pitch)**

2. Applications

- **Power Bank, Portable Charger**
- **Smart Phones, Tablets and Portable devices**

3. Description

IP5362 is a highly integrated power management SoC that supports FCP, AFC input/output fast charging protocols, USB-C PD2.0/PD3.0 input/output protocols, USB-C PD3.0 PPS output protocols, QC2.0 / QC3.0, SCP output fast charging protocols, integrated synchronous step-up/step-down converter, Li-Ion battery charging management, and battery level indication. Compatible with BC1.2, Apple, Samsung mobile phone fast charging.

The IP5362 requires only one inductor to implement the buck and boost functions, and can be applied with very few peripheral devices to realise a complete solution for fast-charging mobile power. It is easy to achieve a compact overall solution and reduce BOM cost.

The IP5362 supports dual USB-C, one USB-A or optional USB-C output, and one USB-A output at the same time. Fast charge is supported when any output is used independently. When two or more outputs are used simultaneously, only 5V is supported.

The IP5362's synchronous switch discharge system supports a maximum output power of 22.5W, and can maintain an efficiency of more than 90% at a low battery voltage of 22.5W. When unloaded, it automatically enters the sleep state to reduce power consumption.

The IP5362's synchronous switching charging system supports a maximum charging power of 18W and a maximum charging current of 5.0A on the battery side. And built-in chip temperature, battery temperature and input voltage control loop, intelligent regulation of charging current.

The IP5362 has a built-in 14-bit ADC that accurately measures battery voltage and current. Using the built-in power calculation method, the battery power information can be accurately obtained, and the battery power curve can be customized to accurately display the battery power. In addition, the IP5362 supports peripheral resistance PIN options to set battery voltage and battery capacity.

IP5362 supports 1/2/3/4 LED light power display mode, according to the hardware connection intelligent identification of LED number. And support 88, 188 and other digital tube power display mode. In addition, the IP5362 also supports the peripheral resistance PIN option to set the display mode of LED or nixie.

The IP5362 also supports key function and I2C communication interface, which can further expand the function of its application solution.

Contents

4. Reversion History

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● Preliminary release	1

5. Typical Application

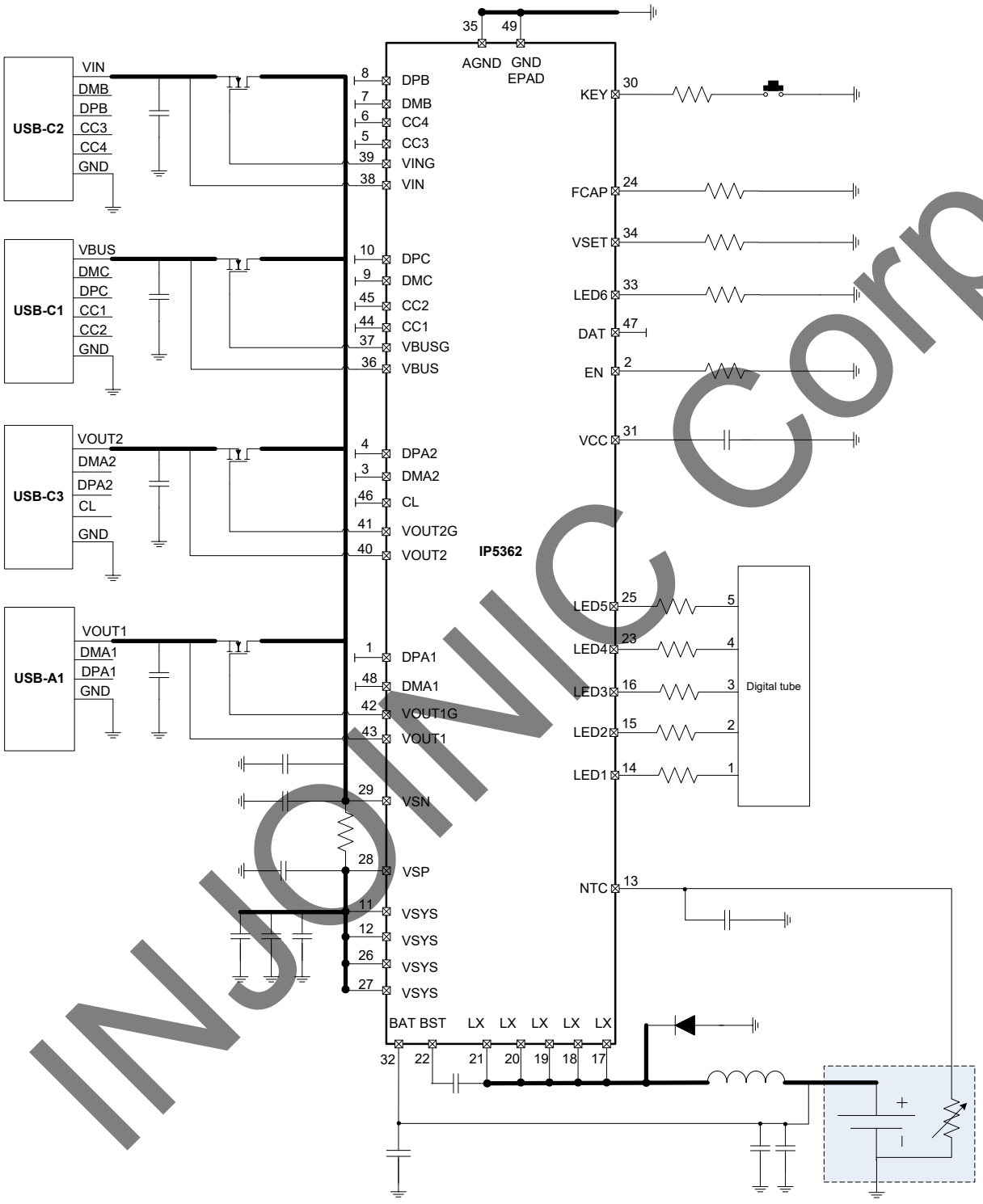


Figure 1 Simplified Application

6. IP Series Products List

6.1. Power Bank IC

IC Part No.	Charge/Boost Power		Main feature								Package	
	Boost Power	Charge Power	LED number	I2C	DCP	USB C	QC	PD3.0/PPS	Super charge	UFCS	Package	Compatibility
IP5303T	5V/1A	5V/1A	1,2	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP5305T	5V/1A	5V/1A	1,2,3,4	√	-	-	-	-	-	-	ESOP8	
IP5306	5V/2.4A	5V/2A	1,2,3,4	√	-	-	-	-	-	-	ESOP8	
IP5306H	5V/2.4A	5V/2A	1,2,3,4	√	-	-	-	-	-	-	ESOP8	
IP5306P	5V/2.1A	5V/2A	1,2,4	√	-	-	-	-	-	-	ESOP8	
IP5316	5V/2.4A	5V/2.4A	1,2,4	√	√	√	-	-	-	-	ESSOP10	
IP5326	5V/2.4A	5V/2.4A	1,2,4	√	√	√	-	-	-	-	QFN16	
IP5407	5V/2.4A	5V/2A	1,2,4	-	√	-	-	-	-	-	ESOP8	
IP5407H	5V/2.4A	5V/2.1A	1,2,4	-	√	-	-	-	-	-	ESOP8	
IP5209	5V/2.4A	5V/2.1A	3,4,5	√	√	-	-	-	-	-	QFN24	
IP5189T	5V/2.1A	5V/2A	1,2,3,4	√	√	-	-	-	-	-	QFN24	
IP5218	5V/1A	5V/1A	1,2,3,4	-	-	√	-	-	-	-	QFN16	
IP5219	5V/2.4A	5V/2A	1,2,3,4	√	-	√	-	-	-	-	QFN24	
IP5310	5V/3.1A	5V/2.6A	1,2,3,4	√	√	√	-	-	-	-	QFN32	
IP5506	5V/2.4A	5V/2A	Nixie Tube	-	-	-	-	-	-	-	ESOP16	
IP5508	5V/2.4A	5V/2A	Nixie Tube	-	√	-	-	-	-	-	QFN32	
IP5320	5V/3.1A	5V/2.6A	Nixie Tube	√	√	√	-	-	-	-	QFN28	
IP5330	5V/3.1A	5V/2.6A	Nixie Tube	-	√	√	-	-	-	-	QFN32	
IP5328P	20W	18W	1,2,3,4	√	√	√	√	√	-	-	QFN40	
IP5353	22.5W	18W	4	√	√	√	√	√	√	-	QFN32	
IP5355	22.5W	18W	4	√	√	Double Lines	√	√	√	-	QFN32	
IP5356	22.5W	18W	Nixie Tube	√	√	Double Lines	√	√	√	-	QFN40	PIN2PIN
IP5356H	22.5W	18W	Nixie Tube	√	√	Double Lines	√	√	√	-	QFN40	
IP5356M	22.5W	18W	Nixie Tube	√	√	Double Lines	√	√	√	-	QFN40	
IP5365	22.5W	18W	Nixie Tube	√	√	Triple lines	√	√	√	√	QFN48	
IP5358	22.5W	18W	Nixie Tube	-	√	√	√	√	√	-	QFN48	
IP5561	22.5W	18W	Nixie Tube	√	√	√	√	√	√	-	QFN48	
IP5569	22.5W	18W	Nixie Tube	√	√	√	√	√	√	-	QFN60	
IP5362	22.5W	20W	Nixie Tube	√	√	Triple lines	√	√	√	-	QFN48	
IP5385	65W	65W	Nixie Tube	√	√	Double Lines	√	√	√	√	QFN48	
IP5386	45W	45W	Nixie Tube	√	√	Double Lines	√	√	√	-	QFN48	
IP5389	100W	100W	Nixie Tube	√	√	Double Lines	√	√	√	-	QFN64	
IP5389H	100W	100W	Nixie Tube	√	√	Double Lines	√	√	√	-	QFN64	

6.2. IP5362 Common Customized Model Description

IC Part No.	battery level display setting pin	Fast charge status indicator	PD Charging Maximum Power	Ultra-low power	Lighting lamp	NTC	I2C	Third Route PD Function
								CL OUTPUT PD
IP5362_ACCCO_LBZ_BA	Fixed LED	LED4	○	○	○	○	●	●
IP5362_ACCCO_BZ_BA	LED5	-	○	○	○	○	●	●
IP5362_AACC_ LBZ_BA	Fixed LED	LED4	○	○	○	○	●	-
IP5362_AACC_ BZ_BA	LED5	-	○	○	○	○	●	-

Supported：●

Customisable：○

Unsupported：-

7. Pin Configuration and Functions

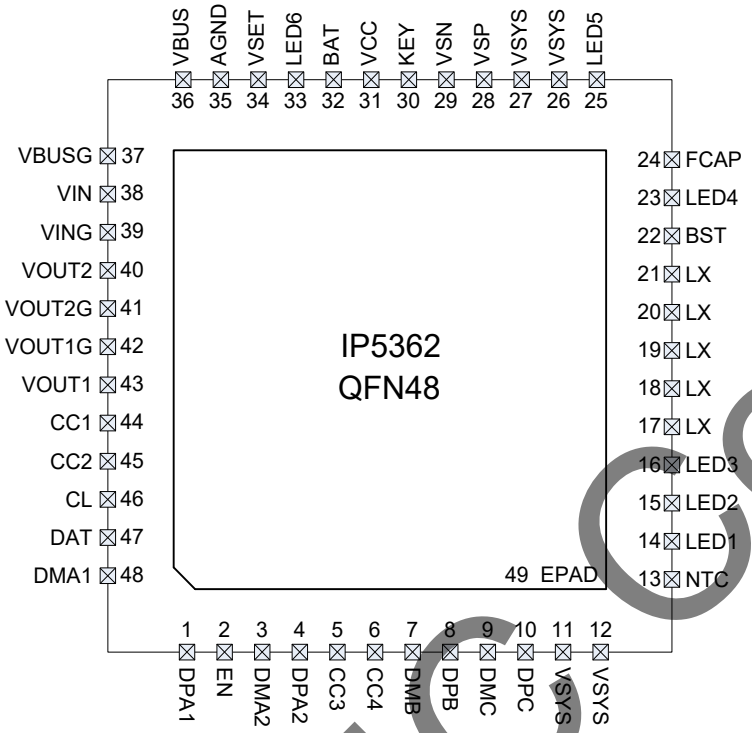


Figure 2 IP5362 Pin Top View

7.1. IP5362 Pin Functions

Pin Num	Pin Name	DESCRIPTION
1	DPA1	USB-A port fast charging intelligent recognition DP pinout
2	EN	10uA low-power mode EN control pin
3	DMA2	USB-C 3-port fast charging intelligent identification DM pinout
4	DPA2	USB-C 3-port fast charging intelligent identification DP pinout
5	CC3	USB-C2 port detects CC3 pin
6	CC4	USB-C2 Port detection CC4 Pin
7	DMB	USB-C2 port fast charging smart identification DM pin
8	DPB	USB-C2 port fast charging smart identification DP pin
9	DMC	USB-C1 port fast charging smart identification DM pin
10	DPC	USB-C1 port fast charging smart identification DP pin
11、12、26、27	VSYS	System input and output common node pins
13	NTC	Temperature detection pin, connect to NTC temperature sensitive resistor
14	LED1	Power display lamp driver LED1 pin, multiplexed to I2C SCL

15	LED2	Power Indicator Lamp Driver LED2 Pin, Multiplexed to I2C SDA
16	LED3	Power display lamp driver LED3 pin, multiplexed to I2C INT
17、18、19、20、21	LX	DC-DC Switch Node, Connection Inductor
22	BST	Internal high-voltage drive pin connected via capacitor to LX
23	LED4	Battery level display lamp driver LED4 pin/fast charging indicator lamp driver pin
24	FCAP	PIN selector pin for setting battery capacity
25	LED5	Power display lamp driver LED5 pin / PIN selector pin for setting LED display mode or digital tube display mode
28	VSP	VSYS Current Sampling Positive, needs to be routed separately from VSYS
29	VSN	VSYS Current Sampling Negative
30	KEY	Key detection pin, muxed to lamp driver pin
31	VCC	Chip 3.3V voltage output pin
32	BAT	Battery Powered Node Pin
33	LED6	Power display lamp driver LED6 pin / PIN selection pin for smart temperature ring threshold inside chip
34	VSET	PIN select pin for setting battery voltage
35	AGND	Analogue ground, good contact with GND required
36	VBUS	USB-C1 port input/output power pins
37	VBUSG	USB-C1 port input/output NMOS control pins
38	VIN	USB-C2 port input/output power pins
39	VING	USB-C2 port input/output NMOS control pins
40	VOUT2	USB-C3 port output power pin
41	VOUT2G	USB-C3 port output NMOS control pin
42	VOUT1G	USB-A port output NMOS control pin
43	VOUT1	Power pin for USB-A port output
44	CC1	USB-C1 port detection CC1 pin
45	CC2	USB-C1 port detection CC2 pin
46	CL	USB-C3 port detection CL pin
47	DAT	Lightning cable decode pin / PIN selector pin to set 2-hour normally open mode or wireless charging mode
48	DMA1	USB-A port fast charging intelligent recognition DM pinout
49(EPAD)	GND	Power ground and heat sink ground, need to maintain good contact with GND

8. Internal structure block diagram

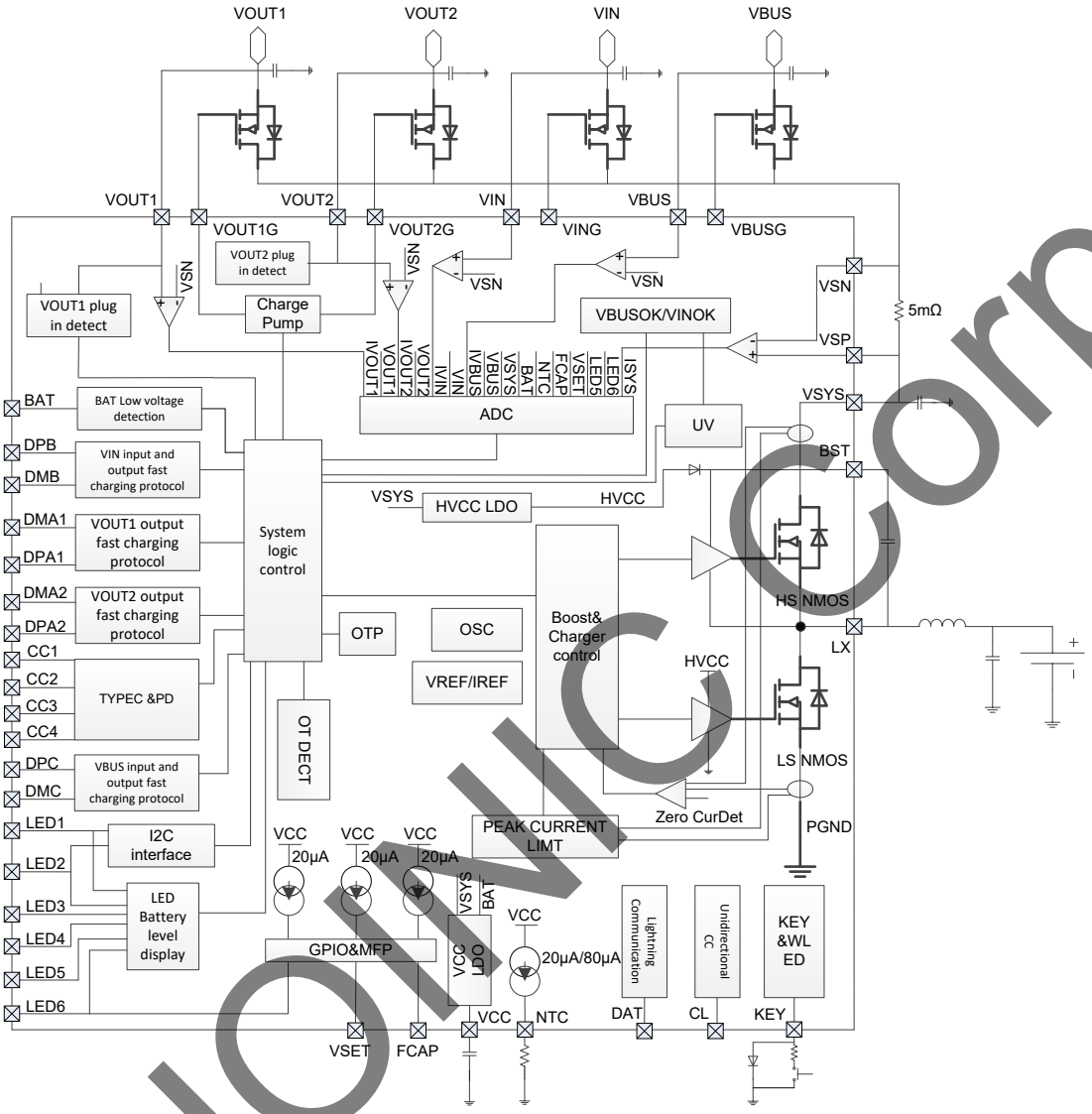


Figure 3 Functional Block Diagram

9. Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Input Voltage Range	V_{IN}, V_{BUS}	-0.3 ~ 16	V
Junction Temperature Range	T_J	-40 ~ 150	℃
Storage Temperature Range	Tstg	-60 ~ 150	℃
Thermal Resistance (Junction to Ambient)	θ_{JA}	35	℃ / W
ESD (Human Body Model)	ESD	4	KV

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

*Voltages are referenced to GND unless otherwise noted.

10. Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	V_{IN}, V_{BUS}	4.5	5 / 9 / 12	14.0	V
Battery Voltage	V_{BAT}	3.0	3.7	4.4	V

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

11. Electrical Characteristics

除特别说明，TA=25℃，L=2.2μH，VBAT=3.8V

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Charging System						
Input voltage	V_{BUS}		4.50	5/9/12	14.00	V
Input Over Voltage	V_{BUS}			14.00		V
Constant Charge Voltage	V_{TRGT}	NMC battery	4.19	4.22	4.25	V
			4.29	4.32	4.35	V
			4.34	4.37	4.39	V
			4.39	4.42	4.45	V
		LFP battery	3.54	3.57	3.59	V
			3.59	3.62	3.65	V
			3.64	3.67	3.69	V
			3.69	3.72	3.75	V
Charge Current	I_{CHRG} Not PD	VIN or VBUS =5V，input current	2.70	3.00	3.30	A
		VIN or VBUS =9V，input current	1.80	2.00	2.20	A
		VIN or VBUS =12V，input current	1.35	1.50	1.65	A
	I_{CHRG} PD	VIN or VBUS PDO	I_{PDO}*0.9	I_{PDO}	I_{PDO}*1.1	A
	I_{CHRG} MAX PD	VIN or VBUS PDO 5V@3.0A	2.70	3.00	3.30	A
		VIN or VBUS PDO 9V@2.22A	2.00	2.22	2.45	A
		VIN or VBUS PDO 12V@1.67A	1.50	1.67	1.85	A
Trickle Charge Current	I_{TRKL}	V_{IN}=5V，V_{BAT}=2.30V		60		mA
		V_{IN}=5V，V_{BAT}=2.80V		250		mA
Trickle Charge Stop Voltage	V_{TRKL}	NMC battery	2.90	3.00	3.10	V
		LFP battery				
Charge Stop Current	I_{STOP}		250	400	550	mA
Recharge Voltage Threshold	V_{RCH}		V_{TRGT}—0.1V			V
Charge Safety Time	T_{END}		20	24	27	Hour

Boost System						
Battery operation voltage	V_{BAT}	NMC battery	3.00		4.45	V
		LFP battery	2.70		3.75	V
Battery input current	I_{BAT}	V_{BAT}=3.7V，V_{OUT}=5.1V，I_{OUT}=0mA	3.00	5.00		mA
DC output voltage	V_{OUT}	QC2.0，V_{OUT}=5V@1A	4.95	5.12	5.23	V
		QC2.0，V_{OUT}=9V@1A	8.70	9.00	9.30	V
		QC2.0，V_{OUT}=12V@1A	11.60	12.00	12.40	V
		QC3.0，@1A	4.95		12.45	V
	V_{STEP}	QC3.0		200		mV
Output voltage ripple	ΔV_{OUT}	VBAT=3.7V，VOUT=5.0V，Fs=350kHz		100		mV
		VBAT=3.7V，VOUT=9.0V，Fs=350kHz		150		mV
		VBAT=3.7V，VOUT=12V，Fs=350kHz		200		mV
Boost output current	I_{out}	V_{OUT}=5V		3.10		A
		V_{OUT}=9V		2.00		A
		V_{OUT}=12V		1.50		A
Boost efficiency	η_{out}	V_{BAT}=3.7V，V_{OUT}=5.0V，I_{OUT}=2.0A		95		%
		V_{BAT}=3.7V，V_{OUT}=9.0V，I_{OUT}=2.0A		93		%
		V_{BAT}=3.7V，V_{OUT}=12.0V，I_{OUT}=1.5A		92		%
Boost overcurrent shut down threshold	I_{shut}	VBAT=3.7V，V_{OUT}=5V	3.40	4.00	4.40	A
		VBAT=3.7V，V_{OUT}=9V	2.25	2.60	2.90	A
		VBAT=3.7V，V_{OUT}=12V	1.70	1.90	2.20	A
Output light load shutdown current	I_{load}	VBAT=3.7V	30	60	100	mA
Load overcurrent detect time	T_{UVD}	Duration of output voltage under 4.2V		1		ms
Load short circuit detect time	T_{OCD}	Output voltage consistently less than VBAT	150		200	μs
Control System						
Switch frequency	Fs	Discharge switch frequency	250	350	450	kHz

		Charge switch frequency	500	600	700	kHz
NMOS on resistance	r_{DSON}	Up NMOS		9	11	mΩ
NMOS on resistance		Downr NMOS		9	11	mΩ
VCC output voltage	V_{CC}	VBAT=3.7V		3.30		V
Battery port standby current	I_{STB}	VBUS=0V ， VBAT=3.7V ， average current		70		μA
VCC output current	I_{VCCLDO}	VBAT=3.7V	40	50	60	mA
LED display driving current	I_{L1} I_{L2} I_{L3}	Voltage decrease 10%		3		mA
Total load Light load shut down detect time	$T1_{load}$	The load current is consistently less than 60mA	25	32	44	s
Output port light load shut down detect time	$T2_{load}$		14	16	18	s
Short press on key wake up time	$T_{OnDebounce}$		60	100	200	ms
Thermal shut down temperature	T_{OTP}	Rising temperature	130	140	150	℃
Thermal shut down hysteresis	ΔT_{OTP}			40		℃

12. Function Description

12.1. Low Voltage Lockout and Activation

IP5362 in the first access to the battery, the chip is in a locked state, the lowest bit of the power lamp or digital tube digits flash 3s; in the non-charging state, if the battery voltage is too low is triggered by a low-power shutdown, the IP5362 will also enter the locked state.

In order to reduce static power consumption, IP5362 does not support mobile phone insertion detection and cannot be activated by pressing the key when the chip is locked. At this time, the key action can not activate the boost output, the lowest bit of the power lamp or digital tube digits blinking 3s to prompt.

When the chip is in the locked state, charging must be accessed to activate the chip function.

12.2. Charge

IP5362 integrates trickle, constant current and constant voltage charging management functions. It can automatically match different charging voltage specifications:

- NMC battery:Trickle charge is used when the battery voltage is <3V; Constant current charging is used when the battery voltage is ⩾3V;
  LFP battery: Trickle charge is used when the battery voltage is <2.7V; Constant current charging is used when the battery voltage is ⩾2.7V;
- Constant voltage charging is used when the battery voltage is close to the set battery voltage;
- Charging stops when the battery voltage is close to the constant voltage and the charging current at the battery end is less than about 500mA;
- After charging is complete, if the battery voltage is detected to be lower than V_{TRGT}—0.1V, switch the battery charging back on;

IP5362 adopts synchronous switching charging technology with a switching frequency of 600kHz, and when charging with fast charging input, the input power is up to 20W, and the maximum charging efficiency is up to 93%, which can shorten the charging time by 3/4. Moreover, IP5362 supports the function of charging and discharging at the same time, when charging and discharging at the same time in USB port, the input and output are in 5V mode; when charging and discharging at the same time in wireless charging and USB port, the input and output both support the maximum 12V fast charging.

12.11.1. Adaptive charging current

IP5362 integrates charging current adaptive function. IP5362 integrates input under-voltage loop, which can adaptively adjust the charging current according to the input voltage; integrates intelligent recognition of charging protocol function, which can match different charging currents according to the input protocol; integrates intelligent recognition of input PDO function, which can intelligently match the input current according to the PDO.

- Intelligently adjusts the charging current according to the input undervoltage loop;

  The IP5362 integrates an input undervoltage loop control system that monitors the input voltage in real time and dynamically adjusts the current. When the input voltage falls below a preset threshold, the chip will automatically implement a gradient charging current decay algorithm to ensure the safety and stability of the charging process.

- Intelligent matching of charging current based on DPDM protocol and Type-C CC protocol detection results;

IP5362 is equipped with a multi-protocol intelligent recognition engine, which enables intelligent matching of charging current according to the input protocol.

The final charging current is determined by IMax(DCP, CC) optimisation algorithm. The charging current adaptive adjustment mechanism is shown in the table below:

Chart 1 Charge current adaptive matching table

DPDM test results	CC test results	Theoretical charging current	DPDM test results	CC test results	Theoretical charging current
Apple 2.4A	default	2.4A	Samsung 2.0A	default	2.0A
	CC1.5A	2.4A		CC1.5A	2.0A
	CC3.0A	3.0A		CC3.0A	3.0A
Apple 2.0A	default	2.0A	Float	default	3.0A
	CC1.5A	2.0A		CC1.5A	3.0A
	CC3.0A	3.0A		CC3.0A	3.0A
Apple 1.0A	default	1.0A			
	CC1.5A	1.5A			
	CC3.0A	3.0A			

- Intelligently matches the charging current to the PDO broadcast by the adapter;

Chart 2 Charge current adaptive matching table

Adapter Broadcast PDO	Theoretical maximum charging current
15W (5V@3.0A\9V@1.67A\12V@1.25A)	15W (5V@3.0A\9V@1.67A\12V@1.25A)
18W (5V@3.0A\9V@2.0A\12V@1.5A)	18W (5V@3.0A\9V@2.0A\12V@1.5A)
20W (5V@3.0A\9V@2.22A\12V@1.67A)	20W (5V@3.0A\9V@2.22A\12V@1.67A)
25W (5V@3.0A\9V@2.78A\12V@2.08A)	20W (5V@3.0A\9V@2.22A\12V@1.67A)
Non-PD protocols	18W (5V@3.0A\9V@2.0A\12V@1.5A)

12.3. Boost

The IP5362 integrates a high-voltage output synchronous switching converter system with a switching frequency of 350kHz. It supports a wide voltage range output of 5V~12V. 负载能力分别为 5V@3.1A, 9V@2.22A, 12V@1.67A.

The IP5362's built-in output soft-start function prevents malfunctions caused by excessive inrush current during startup. In addition, the IP5362 also integrates output over-current, short-circuit, over-voltage, over-temperature and other protection functions, which can ensure stable and reliable operation of the system.

The output current of the discharge system can be automatically adjusted with the temperature to ensure that the chip temperature is below the set temperature.

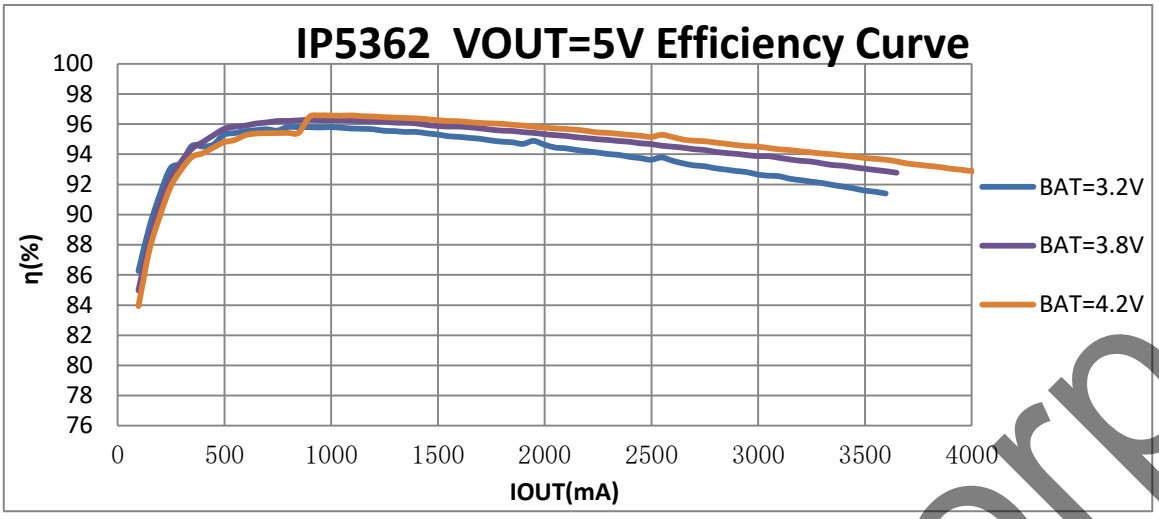


Figure 4 VOUT=5V Efficiency Curve

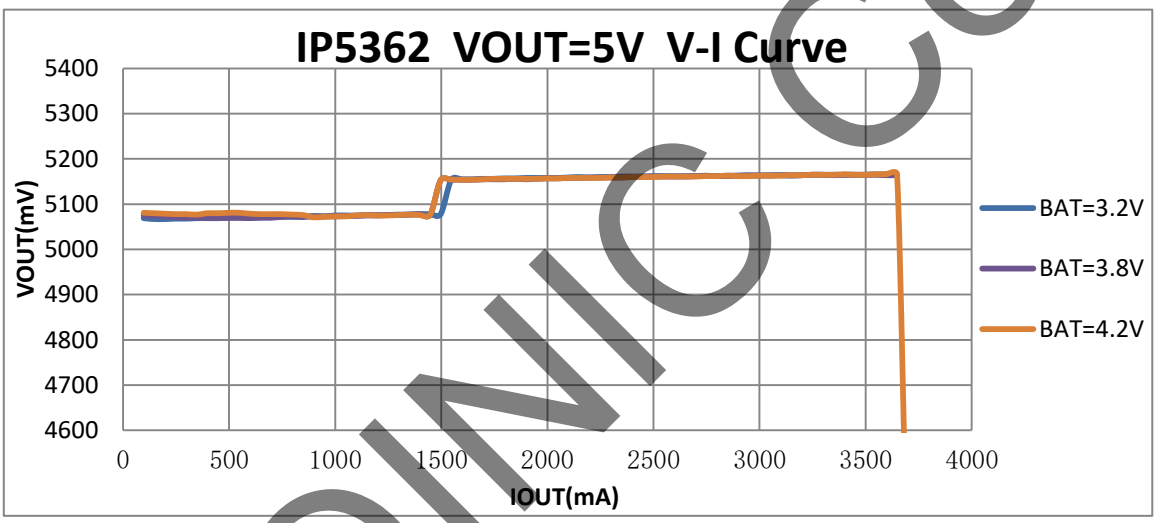


Figure 5 IP5362 VOUT=5V V-I Curve

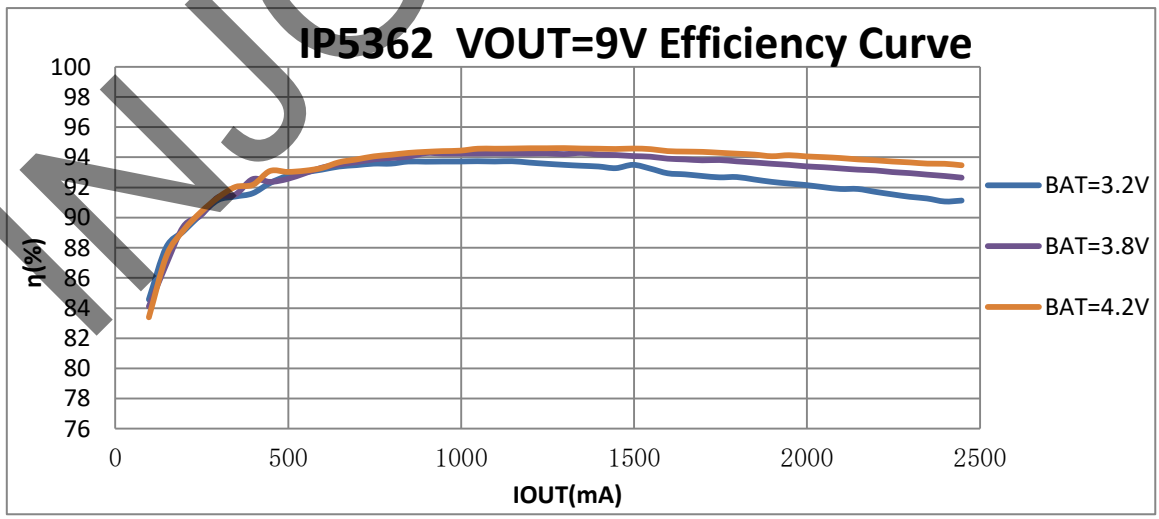


Figure 6 IP5362 VOUT=9V Efficiency Curve

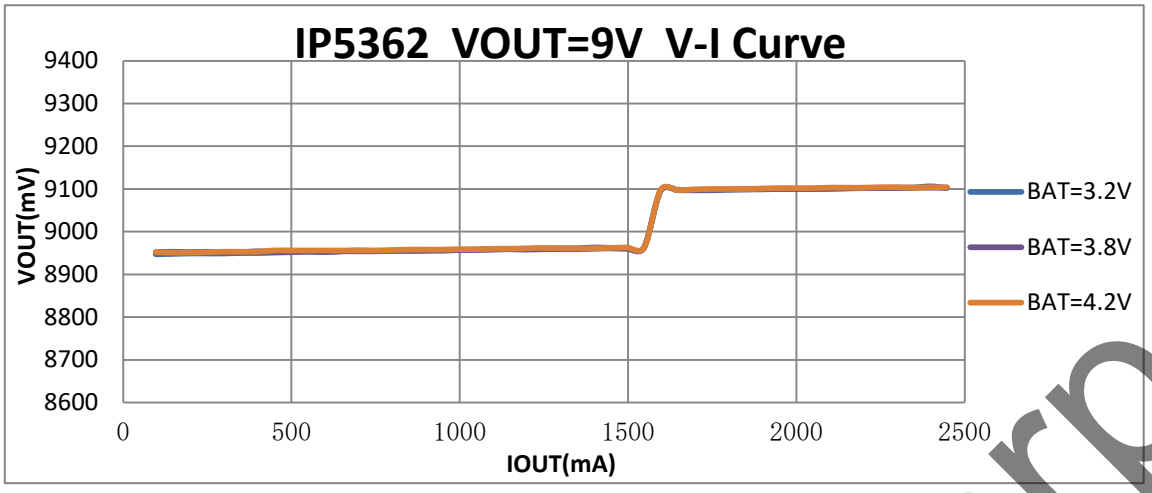


Figure 7 IP5362 VOUT=9V V-I Curve

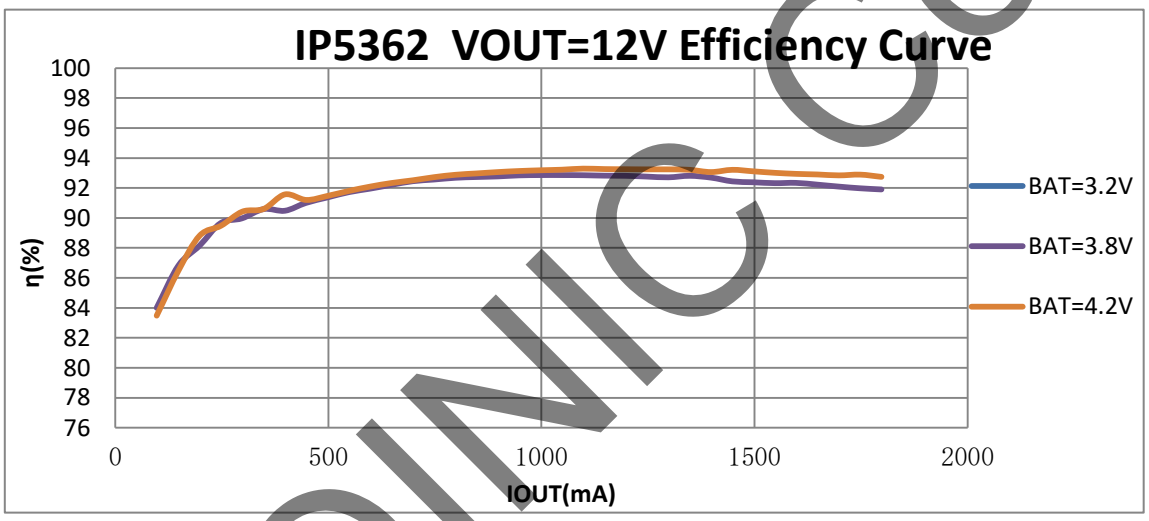


Figure 8 VOUT=12V Efficiency Curve

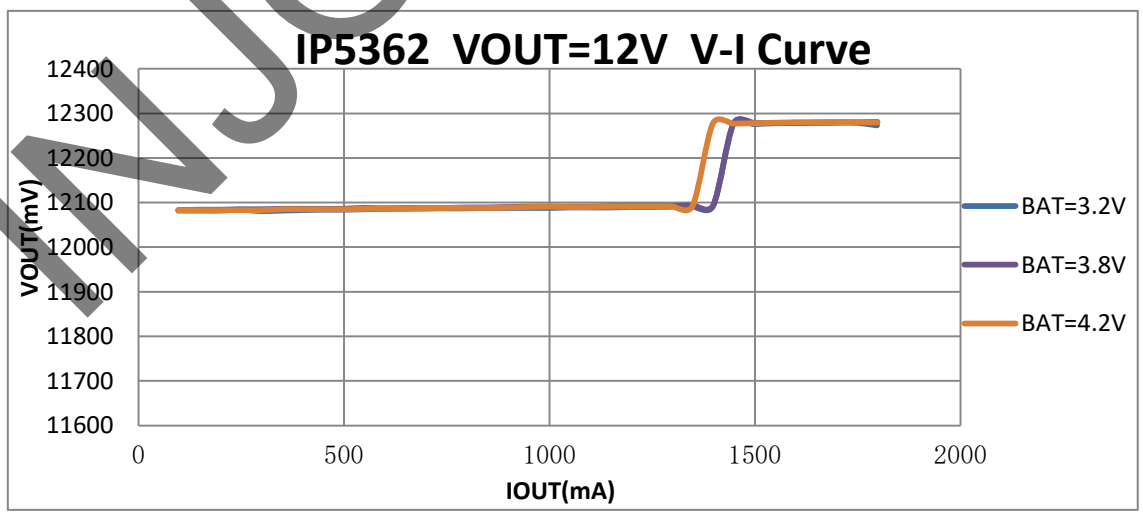


Figure 9 IP5362 VOUT=12V V-I Curve

12.4. USB C

IP5362 integrated USB C DRP port, auto-switching the internal pull-up and pull-down circuit on CC1 and CC2 by distinguishing the role of the attached device. Support Try.SRC function, when the attached device is also DRP device, IP5362 will supply power for the opposite device.

When worked as DFP, the output current can be set as three levels; when worked as UFP, the current capability from the opposite device can be detected.

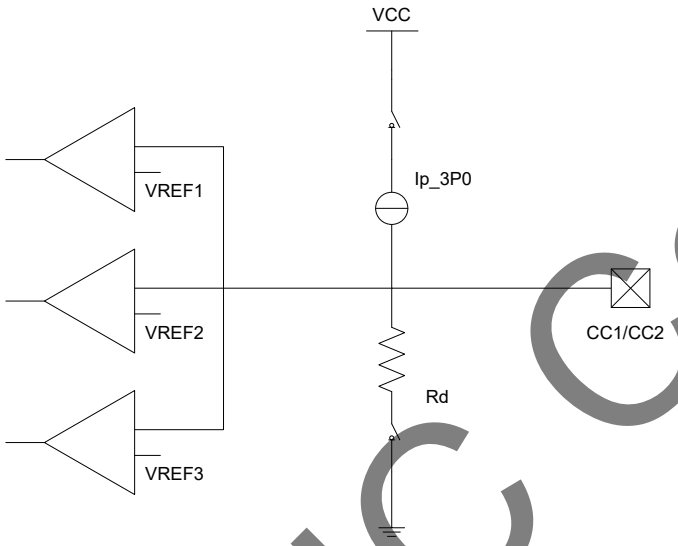


Figure 10 CC internal circuit

Chart 3 Pull-up and pull-down ability

Name	Value
Ip_3P0	330μA
Rd	5.1kΩ

Chart 4 Comparator Threshold of pull-up Ip

	Minimum Voltage	Maximum Voltage	Threshold
Powered cable/adapter (vRa)	0.00V	0.75V	0.80V
Sink (vRd)	0.85V	2.45V	2.60V
No connect (vOPEN)	2.75V		

Chart 5 Comparator Threshold of Pull-down Resistor Rd

Detection	Min voltage	Max voltage	Threshold
vRa	-0.25V	0.15V	0.20V
vRd-Connect	0.25V	2.04V	
vRd-USB	0.25V	0.61V	0.66V
vRd-1.5	0.70V	1.16V	1.23V
vRd-3.0	1.31V	2.04V	

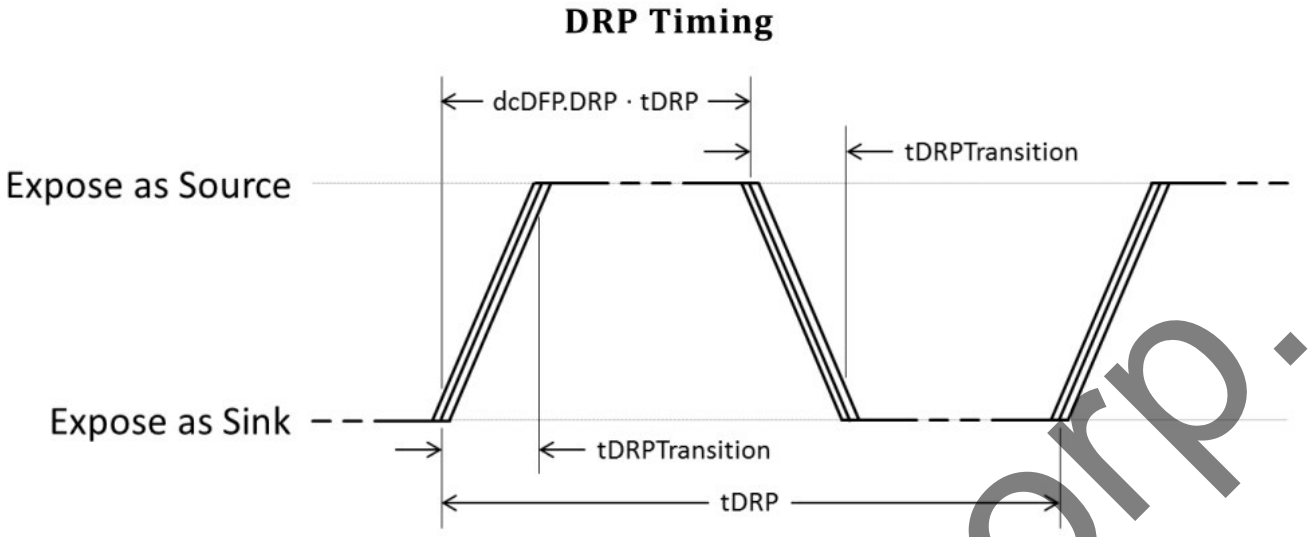


Figure 11 USB C detects cycle

Chart 6 USB C detects cycle

	Minimum	Maximum	Description
tDRP	50ms	100ms	The period a DRP shall complete a Source to Sink and back advertisement
dcSRC.DRP	30%	70%	The percent of time that a DRP shall advertise Source during tDRP
tDRPTransition	0ms	1ms	The time a DRP shall complete transitions between Source and Sink roles during role resolution
tDRPTry	75ms	150ms	Wait time associated with the Try.SRC state
tDRPTryWait	400ms	800ms	Wait time associated with the Try.SNK state

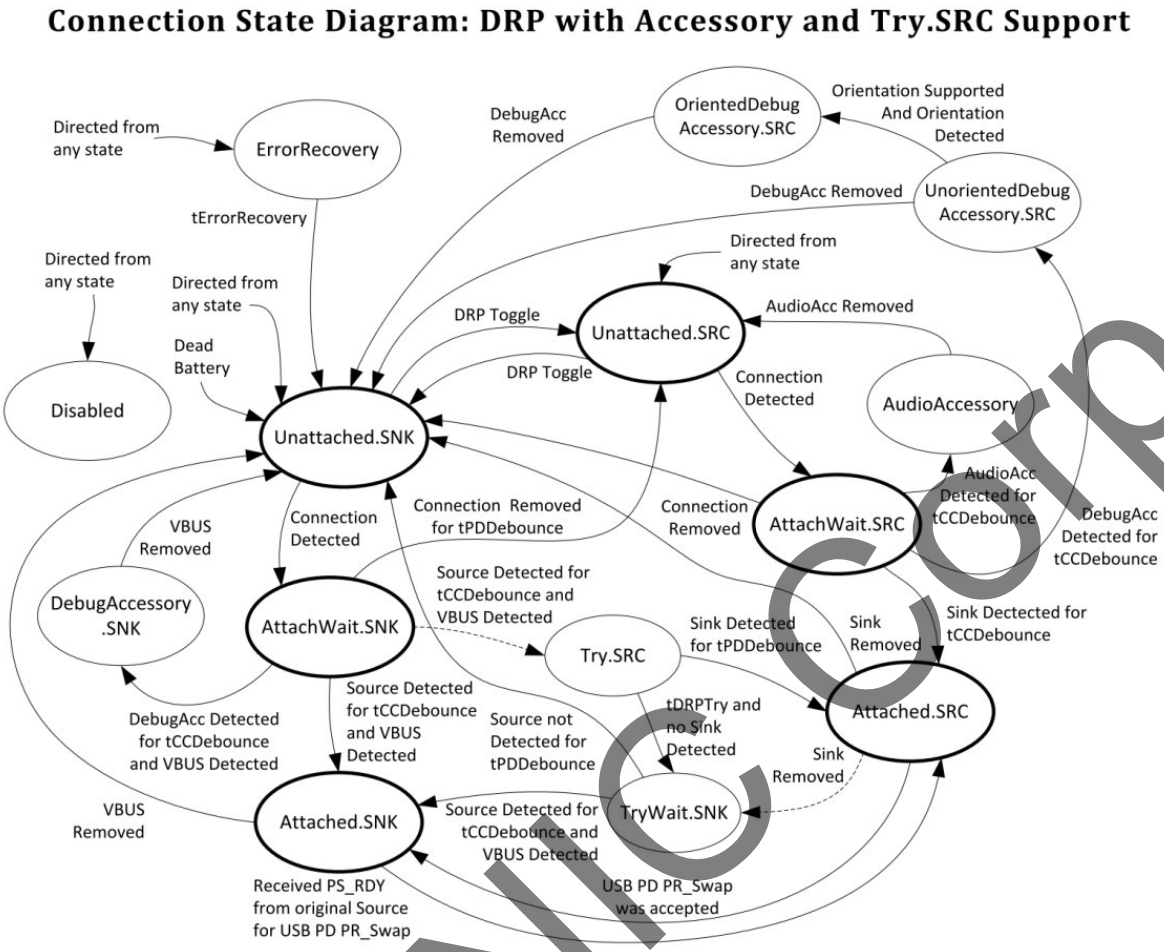


Figure 12 USB C detects state transition

12.5. PD protocol

The IP5362 integrates Power Delivery PD2.0/PD3.0/PPS protocols, an integrated physical layer protocol (PHY), and a hardware bi-directional marking codec (BMC) module.

IP5362 input/output both support PD2.0/PD3.0 protocol, and the output support PPS protocol. IP5362 input/output both support 5V, 9V, 12V three gears, 输出广播 PDO 支持 5V@3.0A, 9V@2.22A, 12V@1.67A, PPS 5.0V~11V@2A, support 22W power output.

12.6. Fast Charge Protocol

IP5362 supports multiple specifications of fast charging protocols: PD2.0/PD3.0/PPS, QC2.0, QC3.0, FCP, AFC, SCP, Apple, Samsung.

Charging IP5362 can support FCP, AFC fast charging input, but does not support QC2.0, QC3.0 function or external fast charging protocol chip. Since FCP, AFC are fast charging handshake request through DP/DM, it can no longer support FCP, AFC fast charging if other fast charging protocol chips are added.

When IP5362 is charging mobile phones: it automatically detects the fast charging timing on DP and DM pins, intelligently identifies the type of mobile phone, and can support mobile phones with

QC2.0/QC3.0, FCP, AFC, and SCP protocols, and supports Apple 2.4A mode, Samsung 2A mode, and BC1.2 common Android 1A mode.

For Apple 2.4A mode: DP=DM=2.7V

For Samsung 2.0A mode: DP=DM=1.2V

For BC1.2 1.0A mode: DP short to DM

Under BC1.2 mode, when the DP voltage is detected in the range of 2V ~ 0.325V for 1.25s, fast charge will be initially determined, then the short status between DP and DM will be disconnected, and DM pull-down 20kOhm to GND at the same time. After which, if in the following 2ms the DP voltage is in range of 2V ~ 0.325V and DM lower than 0.325V, fast charge handshake is accomplished successfully. Then QC2.0/QC3.0 device can request for desired voltage according to the QC standards. Any time DP lower than 0.325V will force to exit the fast charge mode, the ouput voltage will fall back to default 5V.

Chart 7 QC2.0/QC3.0 output voltage request rule

DP	DM	Result
0.6V	GND	5V
3.3V	0.6V	9V
0.6V	0.6V	12V
0.6V	3.3V	Continue Mode
3.3V	3.3V	sustain

Continuous mode is supported by QC3.0, voltage can be adjusted by 0.2V / step according to QC3.0 request under the continues mode.

Chart 8 Fast charging protocol supported by each port of IP5362

Protocols	USB-C1 input port	USB-C1 output port	USB-C2 input port	USB-C2 output port	USB-C3 output port Used as USB-C port)	USB-C3 output port Used as USB-A port)	USB-A output port
QC2.0	-	•	-	•	•	•	•
QC3.0	-	•	-	•	•	•	•
AFC	•	•	•	•	•	•	•
FCP	•	•	•	•	•	•	•
SCP	-	•	-	•	•	•	•
PD2.0	•	•	•	•	•	-	-
PD3.0	•	•	•	•	•	-	-
PPS	-	•	-	•	•	-	-

Supported：•

Unsupported：-

12.7. Charge and Discharge Path Management

Standby:

If the USB-C port connected to the VBUS/ VIN pin is plugged into a charging power supply, the charging function can be activated directly.

If the USB-C port connected to the VBUS/ VIN/ VOUT pins is plugged into a USB-C UFP device, the discharge function can be enabled automatically.

If there is a key action and there is a load connected to the VBUS, VIN, VOUT1 and VOUT2 ports, the corresponding output port will be turned on, otherwise the output port will remain off.

Discharge:

When there is no key action, only the output port of the connected power equipment will be turned on, and the output port of the unconnected power equipment will remain closed. When the output current is less than 60mA and continues for a certain period of time, the output port in the open state will be closed automatically.

VBUS, VIN, VOUT1 and VOUT2 all support output fast charging. As the solution is a single inductor solution, only one output voltage can be supported at the same time, so only one output port supports fast charging output when it is turned on. When two or more output ports are used at the same time, the output fast charging function will be automatically turned off.

As shown in the 'Typical Application Schematic', after any output port enters the fast charging output mode, if other output ports are plugged into the power device, IP5362 will first shut down all the output ports (shut down the fast charging function), and then restart the output ports that have the power device connected, and at this time, all the output ports only support the Apple, Samsung, BC1.2 mode charging. BC1.2 mode charging. If the number of power devices is reduced to only one power device, IP5362 will turn off all the output ports first, and then turn on the output port of the existing power device only (this function requires special attention to PCB Layout alignment, otherwise the automatic resumption of the fast charging function will be ineffective, refer to Layout Notes), in this way, to re-activate the fast charging of the request of the power device. If the open output ports are less than two, the output current is less than 60mA and lasts for about 32s, IP5362 will turn off the output ports and discharge function, and enter the standby state.

Charging:

Connect any of the USB-C ports of the VBUS and VIN pins and plug in the charging power supply to charge.

In single charging mode, IP5362 will automatically recognise the fast charging mode of the charging power source and automatically match the appropriate charging voltage and charging current.

Charging and discharging at the Same Time:

When the USB port is plugged with both the charging power supply and the power-using device, IP5362 will automatically enter the charging and discharging mode. In this mode, the chip will automatically turn off the internal fast charging function, and then turn on the discharge path of the USB port to supply power to the power-using device when the VSYS voltage is only 5V, and will not turn on the discharge path of the USB port if the VSYS voltage is greater than 8V for safety reasons. In order to

ensure the normal charging of the power-using devices, IP5362 will increase the undervoltage threshold of the charging loop to more than 4.9V to ensure the priority of power supply to the power-using devices.

During the charge-and-discharge process, if the charging power supply is disconnected, the IP5362 automatically switches off the charging function and then restarts the discharging function to reactivate the phone's fast charging request. For safety reasons, the output voltage will be 0V for a short period of time during the conversion process.

During the charging and discharging process, IP5362 will automatically close the corresponding discharge path if you disconnect the USB power-using device, or if the power-using device is full and stops pumping power for 16s. When all the discharge paths are closed and the state returns to single charging mode, IP5362 will lower the undervoltage threshold of the charging loop and automatically reapply for fast charging to accelerate the charging of the mobile power.

12.8. Automatic detection of mobile phone

Insertion detection function:

IP5362 can achieve automatic detection of mobile phone insertion action. When the mobile phone is inserted, it instantly wakes up from the standby state and turns on the output 5V to charge the mobile phone without the need of key operation, so it can achieve the mould keyless solution.

Fullness detection function:

IP5362 samples the output current of each USB port through ADC, when the output current of a single port is less than 60mA and lasts for 16s, it will automatically shut down that output port. When the total current is less than 60mA and lasts for 32s, it is regarded that the power-using devices of all output ports are full or unplugged, and it will automatically turn off the boost output and enter the standby mode.

12.9. KEY

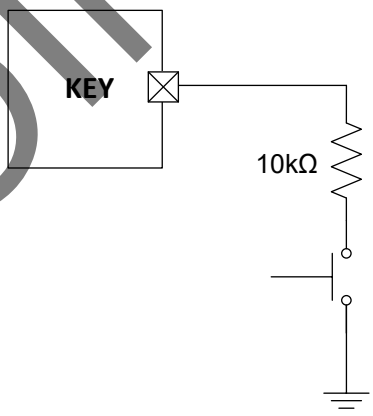


Figure 13 KEY circuit

The key connections are shown in Figure 13.

- Key duration longer than 100ms, but less than 2s, is short press action. Short press will turn on the power display lamp and boost output;
- A key press lasting longer than 2s is a long press action with no function;
- Keystrokes less than 30ms will not respond;
- Two consecutive short presses within 1s will switch off the boost output, power display;

12.10. WLED

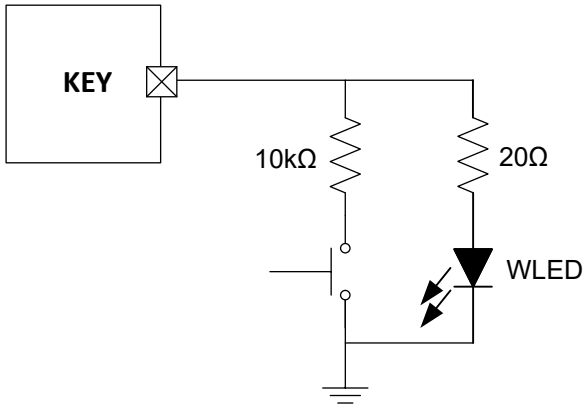


Figure 14 WLED circuit

The IP5362 supports a torch function that can be customised with a long press to turn the illuminated WLED on or off;

12.11. Fast Charge state indication

LBZ series, LED4 pin can be used as driving fast charging indicator function. Whether charging or discharging, the indicator will automatically light up when it enters the fast charging mode.

* The LED4 pin is not supported to drive the fast charging mode indicator when the BZ series PIN is selected as LED mode.

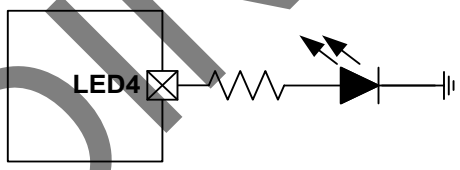


Figure 15 IP5362 LED Model Fast Charge Indicator Circuit

12.12. Coulombmeter and battery level display

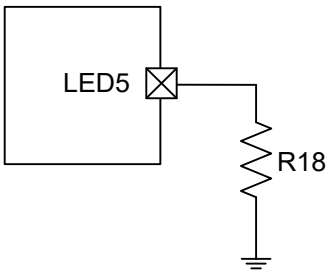
The IP5362 has a built-in power meter function for accurate battery power calculations and supports a variety of power displays:

- LED display: support 1-lamp, 2-lamp, 3-lamp and 4-lamp display, can intelligently identify the number of LED power display lamps according to the hardware connection.
- Digital tube display: support 88, 188 and other digital tube power display.

IP5362 BZ series models support 188 digital tube display mode or LED lamp display mode by setting the resistor connected to LED5 pin:

LED5 pin pull-down 1kΩ to GND: recognised as LED light mode. Intelligent recognition of the number of LED power display lights according to the hardware connection.

LED5 pin dangling: recognised as 188 digital tube mode.



Display mode	R18
LED	1kΩ
Digital tube	NC

Note: This LED mode does not support the LED4 pin to drive the fast charging indicator light

Figure 16 Light display mode configuration circuit

12.11.2. Battery level display for LED mode

IP5362 1-lamp, 2-lamp, 3-lamp and 4-lamp power display lamp connection scheme with the following connections.

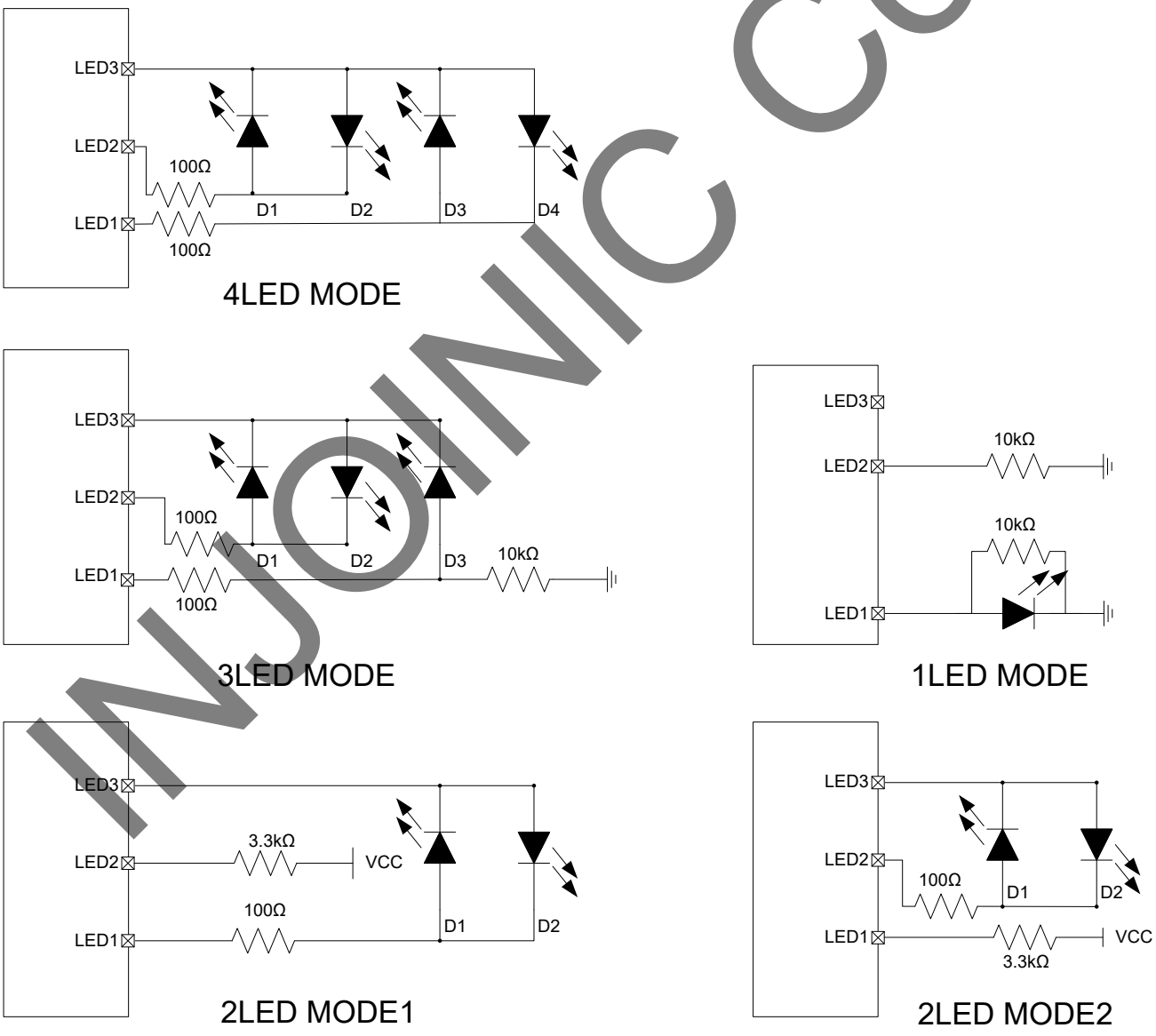


Figure 17 4LED, 3LED, 2LED, 1LED circuits

Chart 9 4LED display mode During charging

Battery capacity (C) (%)	D1	D2	D3	D4
Fully charged	ON	ON	ON	ON
75%≤C	ON	ON	ON	0.6Hz Flash
50%≤C<75%	ON	ON	0.6Hz Flash	OFF
25%≤C<50%	ON	0.6Hz Flash	OFF	OFF
C<25%	0.6Hz Flash	OFF	OFF	OFF

Chart 10 4LED display mode During discharging

Battery capacity (C) (%)	D1	D2	D3	D4
C≥75%	ON	ON	ON	ON
50%≤C<75%	ON	ON	ON	OFF
25%≤C<50%	ON	ON	OFF	OFF
3%≤C<25%	ON	OFF	OFF	OFF
0%<C<3%	1.2Hz Flash	OFF	OFF	OFF
C=0%	OFF	OFF	OFF	OFF

Chart 11 3LED display mode During charging

Battery capacity (C) (%)	D1	D2	D3
Fully charged	ON	ON	ON
66%≤C	ON	ON	0.6Hz Flash
33%≤C<66%	ON	0.6Hz Flash	OFF
C<25%	0.6Hz Flash	OFF	OFF

Chart 12 3LED display mode During discharging

Battery capacity (C) (%)	D1	D2	D3
C≥66%	ON	ON	ON
33%≤C<66%	ON	ON	OFF
3%≤C<33%	ON	OFF	OFF
0%<C<3%	1.2Hz Flash	OFF	OFF
C=0%	OFF	OFF	OFF

Chart 13 2 LED display mode 1 is bi-color LED During charging

Battery capacity (C) (%)	D1	D2
Fully charged	OFF	ON
66%≤C<100%	OFF	0.6Hz Flash
33%≤C<66%	0.6Hz Flash	0.6Hz Flash
C<33%	0.6Hz Flash	OFF

Chart 14 2 LED display mode 1 is bi-color LED During discharging

Battery capacity (C) (%)	D1	D2
66%≤C<100%	OFF	ON
33%≤C<66%	ON	ON
C<33%	ON	OFF
C<3%	1.2Hz Flash	OFF
C=0%	OFF	OFF

2 Lamp Mode 2 is displayed as:
When charging: D1 lamp flashes with 0.6Hz as a cycle (0.8s on, 0.8s off), when full, it is always on.
When discharging: D2 lamp is always on, when the voltage is lower than 3.2V 1.2Hz blinking (0.4s bright, 0.4s extinguished), when the voltage is lower than 3.0V, switch off.

1 Lamp mode is displayed as follows:
when charging: flashing at 0.6Hz (0.8s on, 0.8s off), when full, always on.
When discharging: always on, flashing at 1.2Hz (0.4s on, 0.4s off) when the voltage is lower than 3.2V, and switching off when the voltage is lower than 3.0V.

12.11.3. 188 nixie tube display mode

Chart 15 The 188 nixie tube model IP5362 supported as below

Nixie Tube	During charging		During discharging	
	Not fully charged	Fullly charged	Battery capacity <5%	Battery capacity >5%
188 （YF2252SR-5）	0 - 99% 0.6Hz Flash	100% Constantly on	0 - 5% 1.2Hz Flash	5% -100% constantly on

The 5PIN Type 188 digital tube supported by the IP5362 by default is shown in the schematic below:

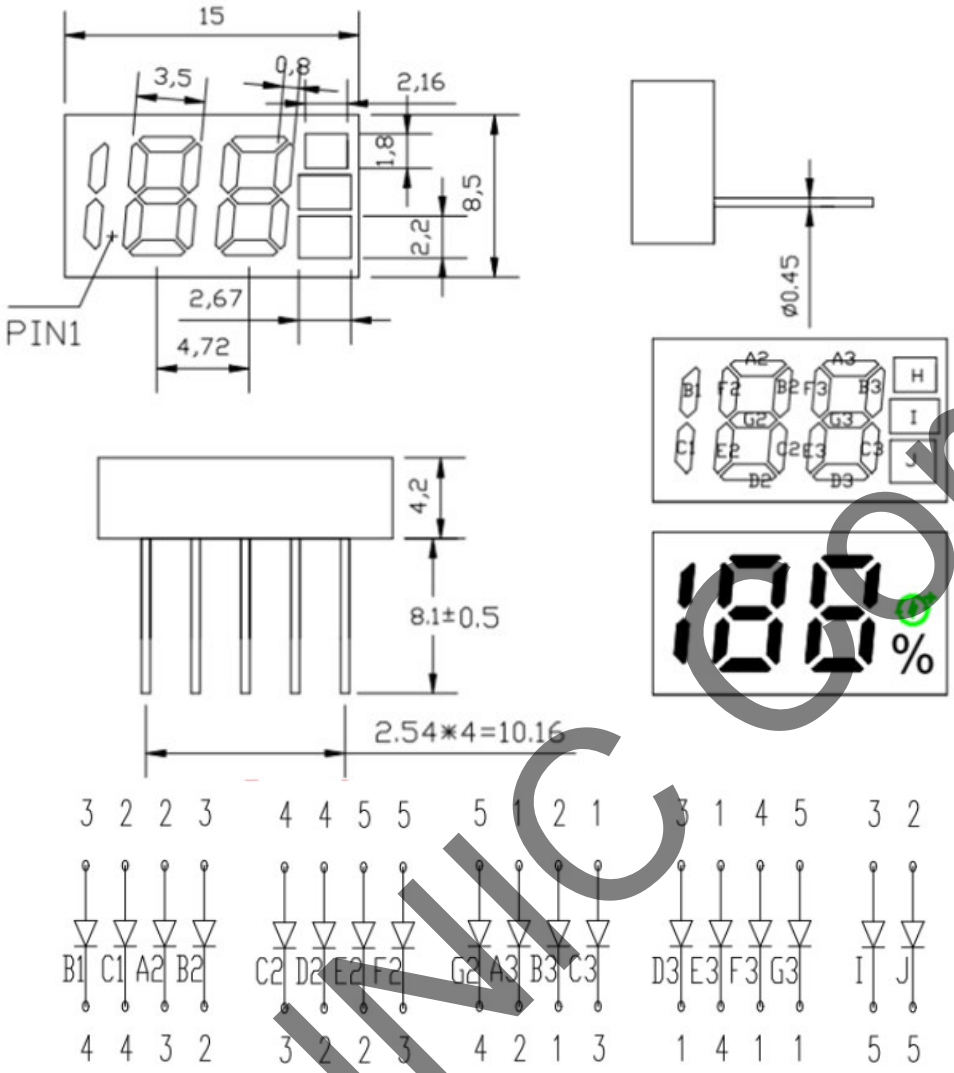


Figure 18 5pin 188 nixie tube circuit

Chart 16 IP5362 Light Drives Drive Pin and Digital Tube Pin Map Relationship

	IP5362 display driver pin	nixie tube pin	note
The 5PIN Type 188 digital tube supported by the IP5362 by default is shown in the schematic below:	LED1(14 PIN)	1 PIN	
	LED2(15 PIN)	2 PIN	
	LED3(16 PIN)	3 PIN	
	LED4(23 PIN)	4 PIN	
	LED5(25 PIN)	5 PIN	
	LED6(33 PIN)	6 PIN	choosable, 6 pin nixie tube

The digital tube PIN pin order mapping relationship should strictly follow the above order.

12.11.4. Coulombmeter

IP5362 supports external setting of the initial capacity of the battery, using the integral of current and time at the battery end to manage the remaining capacity of the battery, and can accurately calculate the current battery capacity.

IP5362 external pin set battery initial capacity formula: battery capacity = RFCAP*0.632 (mAH). Maximum support 60000mAH, larger capacity needs to be customised.

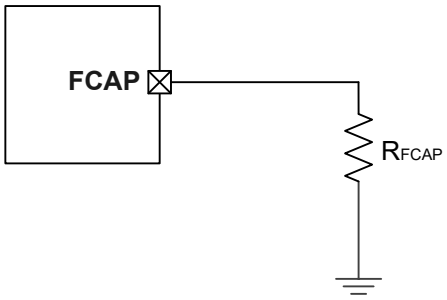


Figure 19 Battery capacity configuration circuit

Chart 17 Typical battery capacity config table

R_{fcap} resistance	battery initial capacity (mAh)=R_{FCAP}*0.632(mAH)
7.9kΩ	5000mAH
15.8kΩ	10000mAH
23.8kΩ	15000mAH
31.6kΩ	20000mAH
39.5kΩ	25000mAH
47.7kΩ	30000mAH
63.2kΩ	40000mAH
79kΩ	50000mAH
94.8kΩ	60000mAH

Note: The unit of RFCAP is Ω, which needs to be converted to Ω for calculation.

12.13. Battery voltage selection（VSET）

The IP5362 supports external setting of battery specifications by connecting a resistor through the VSET pin to set the battery full voltage.

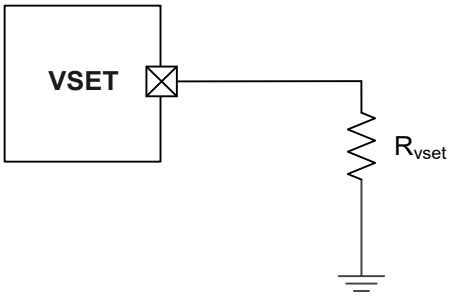


Figure 20 Battery voltage selection configuration circuit

Chart 18 Battery voltage selection config table

R_{VSET}	NMC Battery	LFP Battery
NC	4.20V	3.55V
62kΩ	4.30V	3.60V
33kΩ	4.35V	3.65V
10kΩ	4.40V	3.70V

12.14. NTC function

IP5362 integrated NTC temperature detection function. IP5362 outputs a constant current at the NTC pin and generates a voltage through an external NTC resistor connected to the pin, the chip uses the built-in ADC to detect the voltage at the NTC pin to determine the current temperature.

* In the NTC pin to GND in parallel with the 100nF capacitor, the capacitor requires close to the chip pin placement.

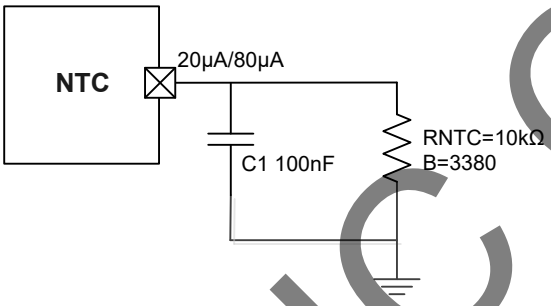


Figure 21 Battery NTC protection detection circuit

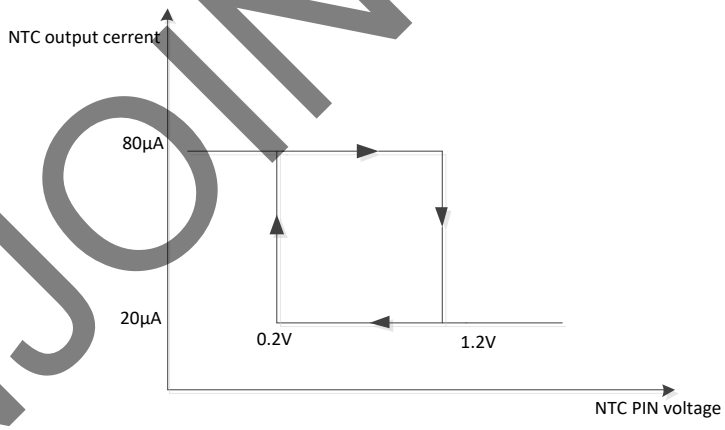


Figure 22 Relationship between NTC voltage and output current

- In order to accurately differentiate the battery temperature detected by the NTC, the NTC uses a current source switching type detection module:

If the output current at the NTC pin is 80 μA and the voltage at the NTC pin is detected to be greater than 1.2 V, the output current at the NTC pin switches to 20 μA;

If the output current of the NTC pin is 20 μA and the voltage of the NTC pin is detected to be lower than 0.2 V, the output current of the NTC pin switches to 80 μA.

- NTC temperature detection:

State of Charge:

When the voltage of the NTC pin is detected to be lower than 0.39V, it indicates that the battery temperature is higher than 45℃ and the charging function is stopped;

When the voltage of the NTC pin is detected to be higher than 0.54V, it indicates that the battery temperature is lower than 0℃ and the charging function is stopped;

State of Discharge:

When the voltage of the NTC pin is detected to be lower than 0.24V, it means that the battery temperature is higher than 60℃ and the discharge function is stopped;

When the voltage of the NTC pin is detected to be higher than 1.38V, it means that the battery temperature is lower than -20℃ and the discharge function is stopped;

- NTC function customization:

When the voltage of the NTC pin is detected to be lower than 0.46V, it means that the battery temperature is higher than 40℃ and the full voltage is reduced by 0.1V;

When the voltage of the NTC pin is detected to be higher than 0.45V, it means that the battery temperature is lower than 5℃ and the charging current is reduced by half;

Note:

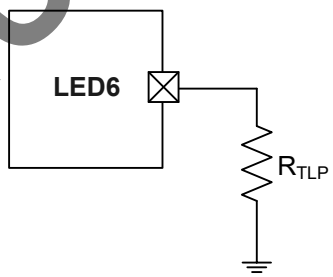
(1) The 100nF capacitor on the NTC pin should be placed close to the chip pin.

(2) If the solution does not require NTC, the NTC pin must be grounded through a 10kΩ resistor, not floating or directly grounded.

12.15. Intelligent temperature selection

The IP5362 has an intelligent temperature control function with built-in high temperature detection protection. This function automatically adjusts the input and output power according to the chip's internal operating temperature, thus maintaining the chip's internal operating temperature below the set temperature threshold.

The IP5362 can be used to set the temperature detection threshold by outputting 20μA current through the LED6 pin and externally connecting different resistors R_{TLP} to GND.



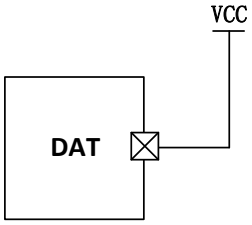
Tep threshold	R_{TLP}
70℃	10k
75℃	25k
80℃	45k
85℃	60k
90℃	80k
95℃	95k
100℃	115k
105℃	130k

Figure 23 Intelligent temperature selection circuit diagram

12.16. Always on mode

The IP5362 supports output normally open 2-hour mode configured via the DAT pin. In the 2-hour mode, the output port will block the light load detection and keep the output open for 2 hours, which is suitable for charging Bluetooth headsets, bracelets and other small-current power-using devices.

The IP5362's output normally open 2-hour mode is configured by pulling the DAT pin up to VCC.



DAT pin status	Mode
Short circuited to VCC	Output normally open for 2 hours
Float	standard

Figure 24 Normally open mode selection circuit diagram

After the IP5362 is configured to output normally-open 2-hour mode via the DAT pin, the standard key functions and indicators of the IP5362 will be changed, and the corresponding mapping relationship is shown in the table below:

Chart 19 Buttons/indicator lights Logic mapping table

Mode	Click the button	Double click the button	Long press the button	Normally open indicator light
Output normally open for 2 hours	Power on/ Normally open off	Entering Normally open	Nothing	LED lights running one by one/ Digital tube rotating in circle
Standard	Power on	Power off	Nothing	Standard

12.17. Wireless charging function

IP5362 supports customised wireless charging output mode. The wireless charging output mode supports an external wireless charging module on VOUT1, which works with the wireless charger to achieve 5W/10W/15W TX function.

The wireless charging output mode of the IP5362, for wireless charging, has the following functional logic:

- IP5362 can achieve fast charging while charging and discharging to the wireless charging module. When VOUT1 supplies power to the wireless charging, it does not affect the VBUS or VIN USB port of IP5362 to apply for input fast charging. If the VBUS or VIN USB port applies for high voltage charging, the wireless charging module can meet the 5W/10W/15W TX function;
- When the VBUS or VIN USB port of the IP5362 is at 5V input, the IP5362 raises the charging undervoltage loop threshold above 4.9V in order to satisfy the power supply to the priority wireless charging module;
- The wireless charger chip sends a level to the KEY pin of the mobile power supply through GPIO. The mobile power supply will judge the light and heavy load status of the USB port of the wireless charger according to the GPIO status sent by the wireless charger, so as to turn off the output of the mobile power supply into standby to save power consumption. This function does not affect the default KEY function of IP5362;

12.17.1. GPIO operation logic of wireless charging section

The VOUT1 port is connected to an external wireless charging module, which switches states through interaction with the DPA1/DMA1/KEY pin of IP5362. The relevant circuit connection diagram is as follows:

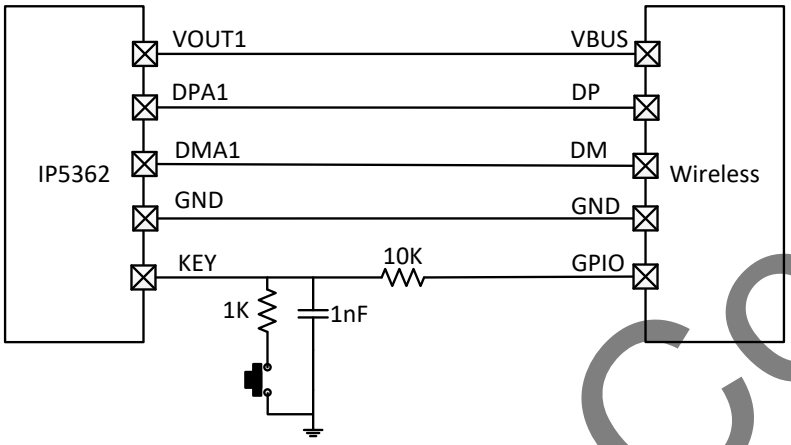


Figure 25 Wireless charging connection circuit diagram

- The wireless charger configures the GPIO as high resistance during the normal discharge state, and the IP5362 detects the KEY as high resistance to judge the wireless charger reloading without turning off the wireless charger output;
- Configure the GPIO to high when the wireless charger is in other states (full, standby), IP5362 detects KEY as high to judge the wireless charger as lightly loaded and turn off the wireless charger output;
- wireless charger needs to wake up the mobile power when the GPIO is configured as low 200ms, IP5362KEY pull down 200ms to force open the output to the wireless charger power supply, can achieve wireless charger self-wake-up function;

Chart 20 Wireless charging GPIO logic mapping table

Status	Wireless charging GPIO status	Note
Wireless charging discharg	High-resistance	
Wireless charging full	High-level	
Wireless charging standby	High-level	
Wireless charging to wake up mobile power supply	200ms low-level	

12.18. VCC

VCC is a normally open 3.3V LDO with a load capacity of 50mA.

12.19. I2C

I2C connection mode:

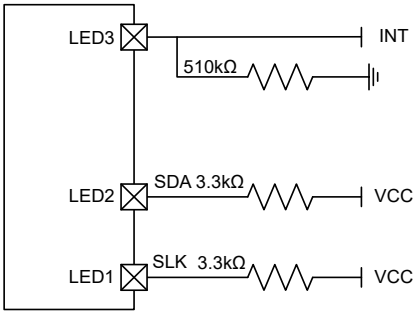


Figure 26 IIC Application method

IP5362 supports I2C connection. If the connection is in the corresponding way, the Function function will be automatically turned off and the I2C mode will automatically enter I2C mode. When the IP5362 is connected to I2C mode, the INT signal is in a high resistance state when standby and in a high level state when working. Used to wake up the MCU.

13. PCB Layout

Here below lists essential precautions that may affect the function and performance on PCB layout, more details will be attached in another document if any.

13.1. Location of USB-A/USB-C1/USB-C2/USB-C3 output capacitors

The 2.2μF capacitor of the IP5362 USB-A/USB-C1/USB-C2/USB-C3 should be placed in parallel and close to the USB socket, and more vias should be added close to the GND terminal of the capacitor to reduce the current between the capacitor and the chip. The area of the circulation is shown in Figures C16, C17, C18, and C19.

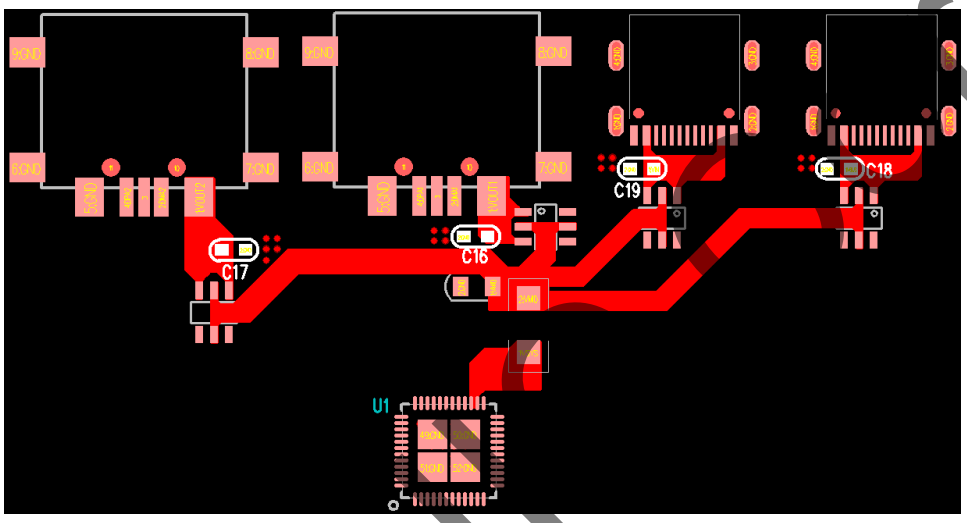


Figure 27 USB-A/USB-C1/USB-C2/USB-C3 output capacitors

13.2. Location of VSYS capacitor

When IP5362 is operating, the position of capacitors on the VSYS network will affect the stability of DC-DC operation. The capacitors on the VSYS network need to be as close to the VSYS pin and EPAD of the chip as close as possible, and copper is laid in a large area near the capacitor pads connected to the VSYS pin, and more vias are added to reduce the circulation area of the current between the capacitor and the chip. , reduce parasitic parameters.

The VSYS pins are distributed on both sides of the chip. Capacitors are required to be placed nearby on both sides of the pins, and the VSYS pins on both sides are connected together on the PCB through wider (not less than 100mil) copper laying. As shown in Figures C6, C8, C9, C12. C7 and CP1 are reserved capacitors and can be NC.

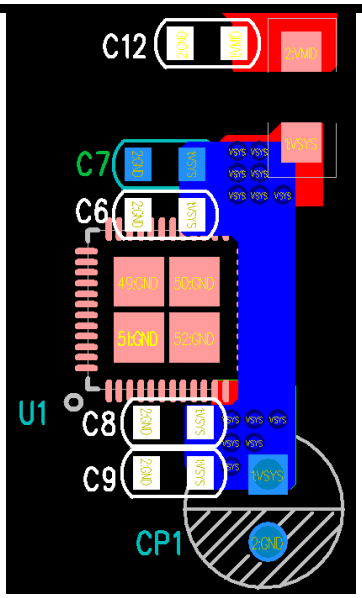


Figure 28 VSYS capacitor

13.3. BAT/VCC /NTC capacitor

The capacitors to ground at the BAT/VCC/NTC pins need to be placed as close to the chip pin as possible, and more vias should be added to the capacitor GND terminal to reduce the area of current circulation between the capacitor and the chip. As shown in Figures C13, C14, C15.

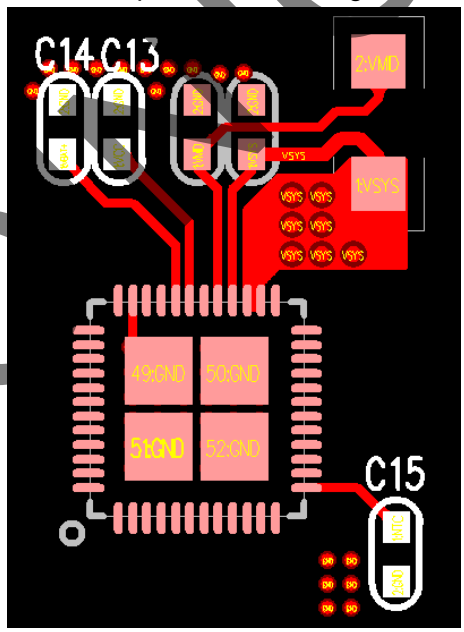


Figure 29 BAT/VCC/VDD/NTC1 capacitor

13.4. Sampling resistor

The chip samples the current flowing through the 5mΩ resistor through the VSN and VSP pins to achieve input and output current control, output overcurrent protection, and output light load shutdown functions. Therefore, when drawing PCB, there are strict requirements for the routing of VSN and VSP pins. When wiring, you must avoid signals with high interference. You must trace them to the inside of the two pads of the 5mΩ sampling resistor, and cannot be matched with VSYS or other There are any overlapping traces in the path through which the current flows. Although VSP and VSYS are the same network on the PCB, the pin routing must be separated.

A 100nF filter capacitor is required to be added to the VSN and VSP pins, and placed as close to the chip pin as possible. At the same time, more vias should be added to the capacitor GND terminal to reduce the circulation area of the current between the capacitor and the chip to enhance the sampling signal. anti-interference ability. As shown in Figures C11 and C10.

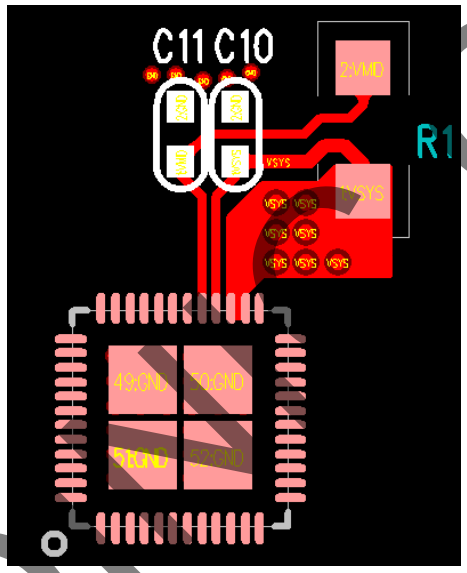


Figure 30 Sampling resistor

13.5. Sampling resistor to output MOS pipeline path

When IP5362 is discharged from multiple ports, it will determine whether the path is in a light load state based on the voltage difference between the two ends of the path MOS. The voltage sampling node is the S pole of the MOS tube and the sampling resistor VSN terminal. During wiring, copper foil is not allowed to overlap in the four current output paths, otherwise there will be a phenomenon that one output port is loaded and other output ports cannot be loaded lightly, resulting in the multi-port discharge being unable to be restored to single-port fast charging.

Take VOUT1 as an example: When there is no current on VOUT1, no other current can flow through any trace from VSN to VOUT1. Otherwise, once current flows through, a pressure difference will be formed, which will be misjudged as VOUT1 upstream. The current out. The same principle applies to other output ports.

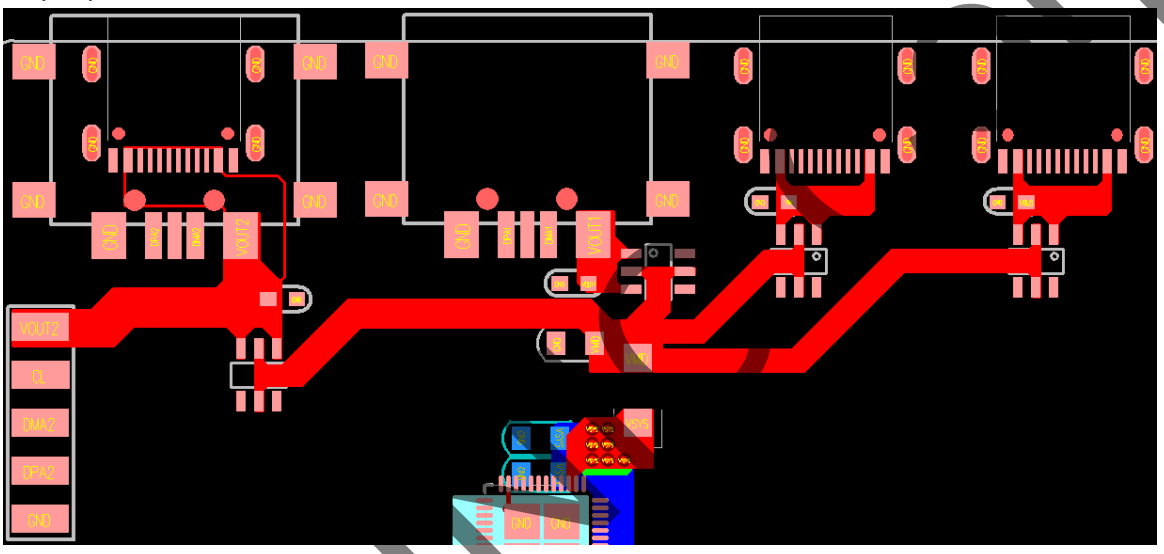


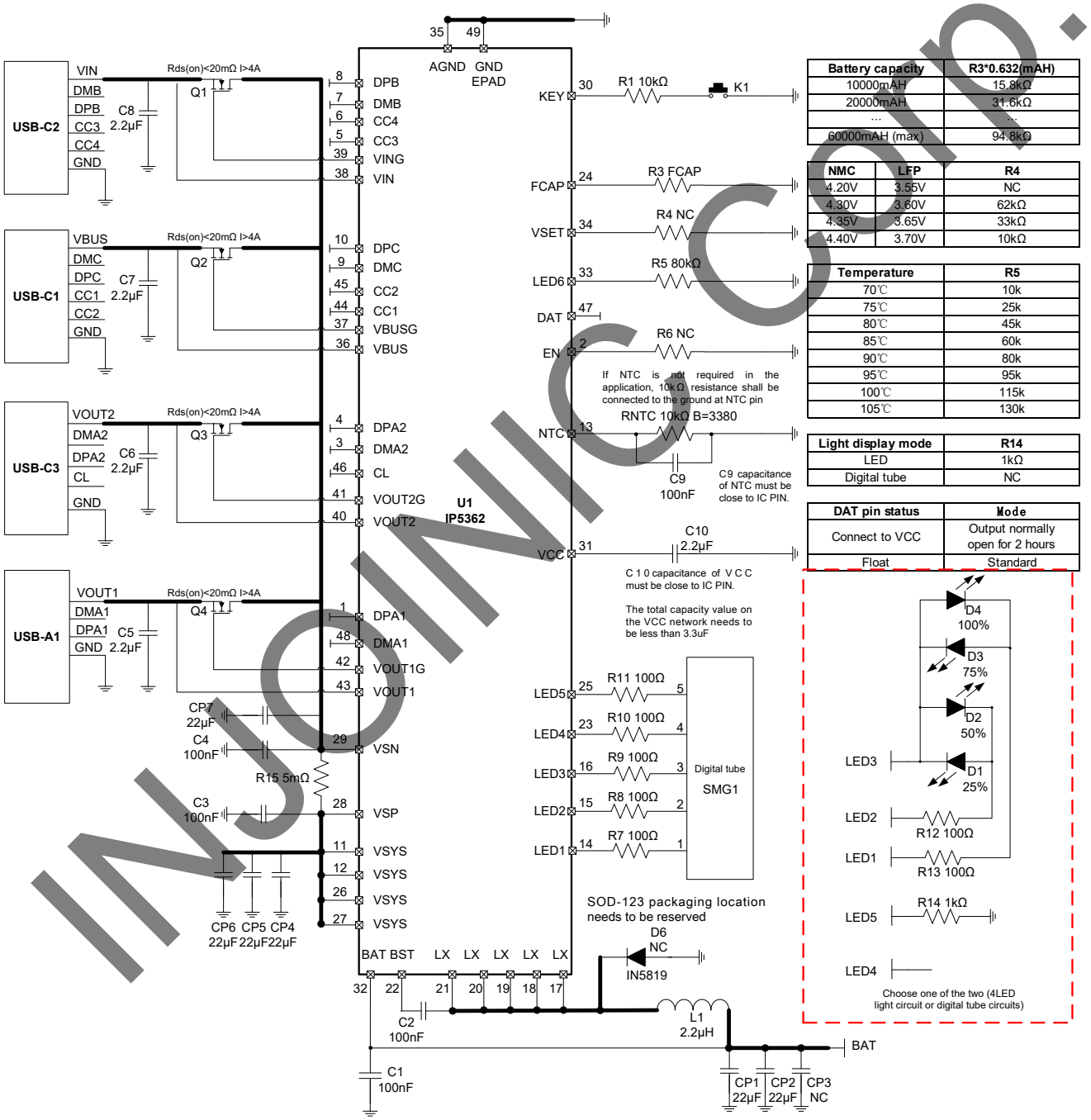
Figure 31 Current output path

14. Typical Application Diagram

IP5362 only requires a small number of passive devices such as MOS tubes, inductors, capacitors, resistors, etc. to achieve a complete function fast charging mobile power supply solution.

14.1. IP5362_ACCCO_BZ application

The IP5362_ACCCO_BZ solution supports 1 USB-A fast charging output, 2 Type-C fast charging input and output, and 1 Type-C fast charging output.



Battery capacity	R3*0.632(mAH)
10000mAH	15.8kΩ
20000mAH	31.6kΩ
…	…
60000mAH (max)	94.8kΩ

NMC	LFP	R4
4.20V	3.55V	NC
4.30V	3.60V	62kΩ
4.35V	3.65V	33kΩ
4.40V	3.70V	10kΩ

Temperature	R5
70℃	10k
75℃	25k
80℃	45k
85℃	60k
90℃	80k
95℃	95k
100℃	115k
105℃	130k

Light display mode	R14
LED	1kΩ
Digital tube	NC

DAT pin status	Mode
Connect to VCC	Output normally open for 2 hours
Float	Standard

Figure 32 IP5362_ACCCO_BZ application circuit

BOM list

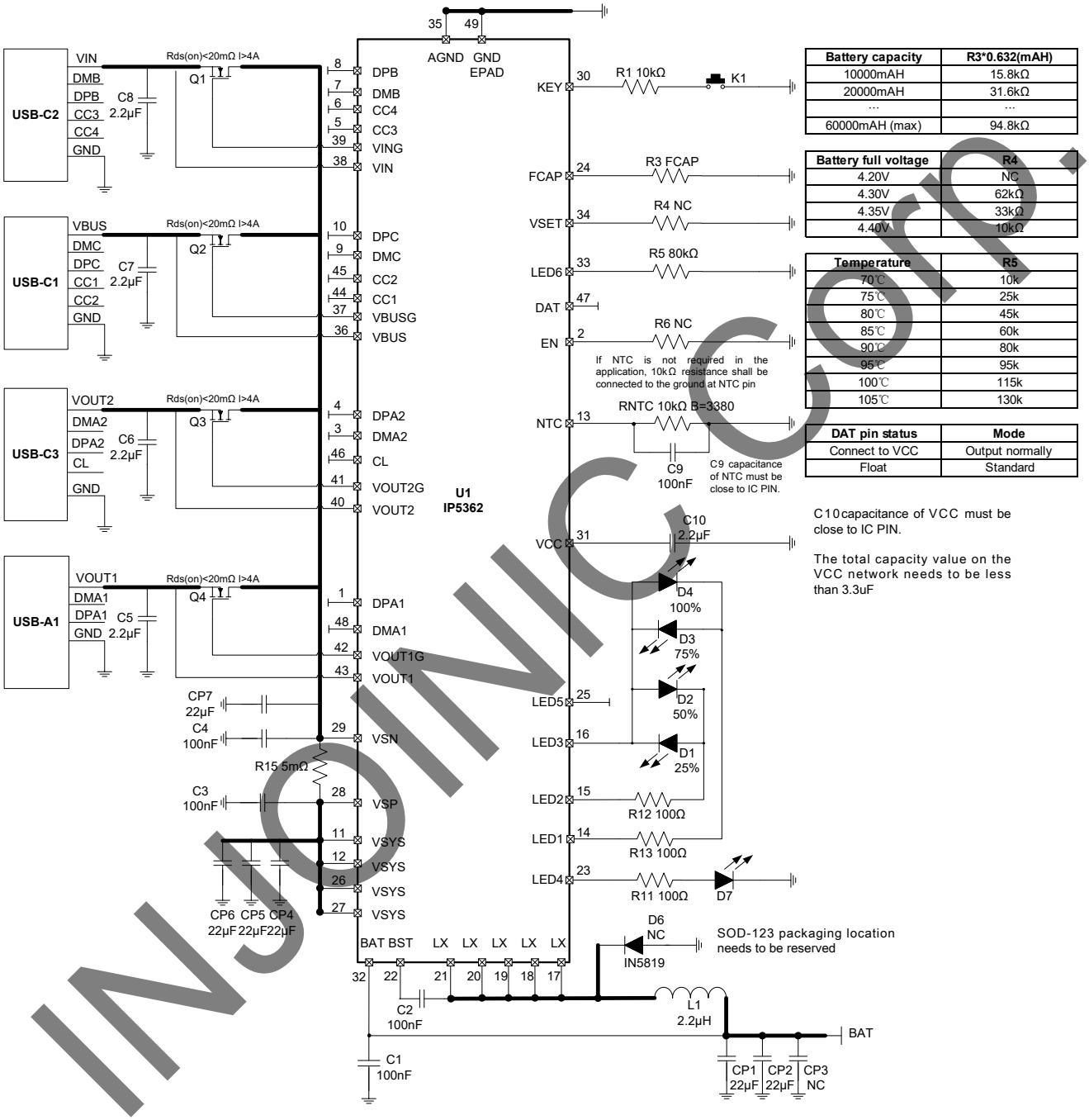
Recommended inductance model：

DARFON PIN	Thickness (mm)	Inductance (uH)	Tolerance	DC Resistance (mΩ)		Heat Rating Current DC Amp.	Saturation Current DC Amps.	Measuring Condition
				Typ.	Max.	Idc(A)Max.	Isat(A)Max.	
SPM70702R2MESQ	5	2.2	±20%	9	10.2	10.5	13.5	100kHz/1.0V
SPM10102R2MESN	4	2.2	±20%	6	7	12	18	100kHz/1.0V
SHC1004-2R2M	4	2.2	±20%	7	9	12	24	

No.	Part Name	Type	Location	Num	Note
1	SMT IC	QFN48 IP5362	U1	1	
2	SMT capacitor	0805 22μF 10% 25V	CP1 CP2 CP3	3	
3	SMT capacitor	0805 22μF 10% 25V	CP4 CP5 CP6 CP7	4	
4	SMT capacitor	0603 100nF 10% 25V	C1	1	
5	SMT capacitor	0603 100nF 10% 25V	C2	1	
6	SMT capacitor	0603 100nF 10% 25V	C3 C4	2	
7	SMT capacitor	0603 100nF 10% 25V	C5 C6 C7 C8	4	
8	SMT capacitor	0603 100nF 10% 25V	C9	1	
9	SMT capacitor	0603 2.2μF 10% 25V	C10	1	
10	SMT resistor	0603 10kΩ 1%	R1	1	
11	SMT resistor	0603 20Ω 1%	R2	1	WLED function needs to be customized
12	LED	5mm WLED	D5	1	
13	SMT resistor	0603 1%	R3	1	R_{FCAP}
14	SMT resistor	0603 1%	R4	1	R_{VSET}
15	SMT resistor	0603 1%	R5	1	R_{TLP}
16	SMT resistor	0603 1%	R6	1	NC
17	SMT resistor	0603 100Ω 1%	R7 R8 R9 R10 R11	5	
18	SMT resistor	0603 100Ω 1%	R12 R13	2	
19	SMT resistor	0603 1kΩ 1%	R14	1	
20	SMT resistor	1206 5mR 1%	R15	1	Sampling resistor PPM＜75
21	NTC THERMAL RESISTOR	10 kΩ@25℃ B=3380	RNTC	1	RNTC
22	SMT LED	0603	D1 D2 D3 D4	4	Choose one of two
23	Nixie tube	YFTD2715AWPG-5D	SMG	1	
24	SMT Schottky	IN5819	D6	1	
25	Inductor	2.2μH 10*10	L1	1	
26	KEY	SMT 3*6	KEY	1	
27	USB C	USB C CONNECTOR	USB-C1 USB-C2	2	
28	USB C Line	USB C Line	USB-C3	1	
29	USB A	AF10 8 USB	USB-A1	1	
30	8205S	SOT-23-6	Q1 Q2 Q3 Q4	4	Rds(on)<10mR>=4A

14.2. IP5362_ACCCO_LBZ application

The IP5362_ACCCO_LBZ solution supports 1 USB-A fast charging output, 2 Type-C fast charging input and output, and 1 Type-C fast charging output.



Battery capacity	R3*0.632(mAH)
10000mAH	15.8kΩ
20000mAH	31.6kΩ
...	...
60000mAH (max)	94.8kΩ

Battery full voltage	R4
4.20V	NC
4.30V	62kΩ
4.35V	33kΩ
4.40V	10kΩ

Temperature	R5
70℃	10k
75℃	25k
80℃	45k
85℃	60k
90℃	80k
95℃	95k
100℃	115k
105℃	130k

DAT pin status	Mode
Connect to VCC	Output normally
Float	Standard

Figure 33 IP5362_ACCCO_LBZ application circuit

BOM list

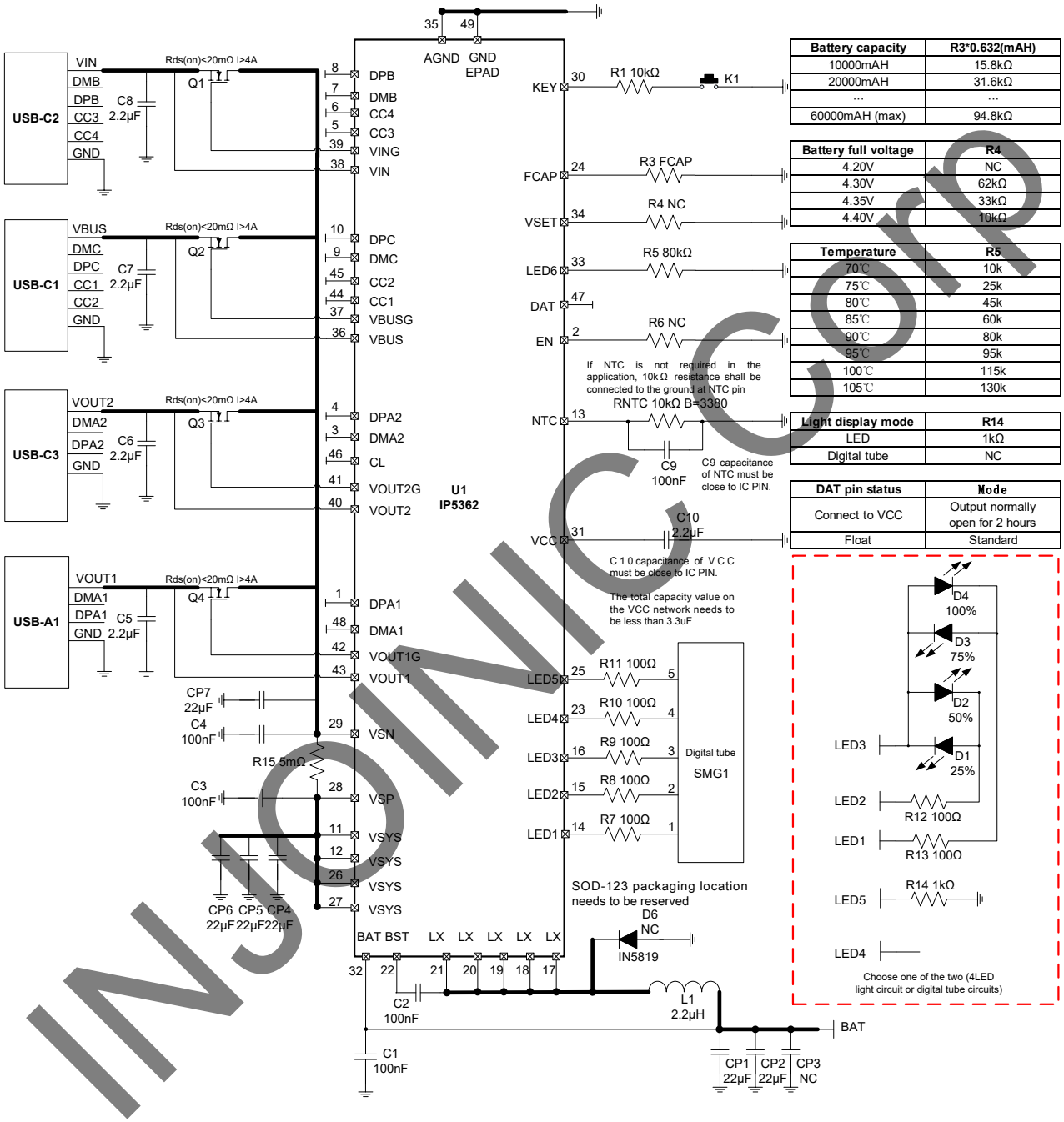
Recommended inductance model：

DARFON PIN	Thickness (mm)	Inductance (uH)	Tolerance	DC Resistance (mΩ)		Heat Rating Current DC Amp.	Saturation Current DC Amps.	Measuring Condition
				Typ.	Max.	Idc(A)Max.	Isat(A)Max.	
SPM70702R2MESQ	5	2.2	±20%	9	10.2	10.5	13.5	100kHz/1.0V
SPM10102R2MESN	4	2.2	±20%	6	7	12	18	100kHz/1.0V
SHC1004-2R2M	4	2.2	±20%	7	9	12	24	

No.	Part Name	Type	Location	Num	Note
1	SMT IC	QFN48 IP5362	U1	1	
2	SMT capacitor	0805 22μF 10% 25V	CP1 CP2	2	
3	SMT capacitor	0805 22μF 10% 25V	CP3	1	NC
4	SMT capacitor	0805 22μF 10% 25V	CP4 CP5 CP6 CP7	4	
5	SMT capacitor	0603 100nF 10% 25V	C1	1	
6	SMT capacitor	0603 100nF 10% 25V	C2	1	
7	SMT capacitor	0603 100nF 10% 25V	C3 C4	2	
8	SMT capacitor	0603 2.2μF 10% 25V	C5 C6 C7 C8	4	
9	SMT capacitor	0603 100nF 10% 25V	C9	1	
10	SMT capacitor	0603 2.2μF 10% 25V	C10	1	
11	SMT resistor	0603 10kΩ 1%	R1	1	
12	SMT resistor	0603 1%	R3	1	R_{FCAP}
13	SMT resistor	0603 1%	R4	1	R_{VSET}
14	SMT resistor	0603 1%	R5	1	R_{TLP}
15	SMT resistor	0603 1%	R6	1	NC
16	SMT resistor	0603 100Ω 1%	R11 R12 R13	2	
17	SMT resistor	1206 5mR 1%	R15	1	Sampling resistor PPM＜75
18	NTC THERMAL RESISTOR	10 kΩ@25℃ B=3380	RNTC	1	RNTC
19	SMT LED	0603	D1 D2 D3 D4	4	
20	SMT LED	0603	D7	1	Fast charging light
21	SMT Schottky	IN5819	D6	1	NC
22	Inductor	2.2μH 10*10	L1	1	
23	KEY	SMT 3*6	KEY	1	
24	USB C	USB C CONNECTOR	USB-C1 USB-C2	2	
25	USB C Line	USB C Line	USB-C3	1	
26	USB A	AF10 8 USB	USB-A1	1	
27	8205S	SOT-23-6	Q1 Q2 Q3 Q4	4	Rds(on)<10mR>=4A

14.3. IP5362_AACC_BZ application

The IP5362_AACC_BZ solution supports 2 USB-A fast charging outputs and 2 Type-C fast charging inputs and outputs.



Battery capacity	R3*0.632(mAH)
10000mAH	15.8kΩ
20000mAH	31.6kΩ
...	...
60000mAH (max)	94.8kΩ

Battery full voltage	R4
4.20V	NC
4.30V	62kΩ
4.35V	33kΩ
4.40V	10kΩ

Temperature	R5
70℃	10k
75℃	25k
80℃	45k
85℃	60k
90℃	80k
95℃	95k
100℃	115k
105℃	130k

Light display mode	R14
LED	1kΩ
Digital tube	NC

DAT pin status	Mode
Connect to VCC	Output normally open for 2 hours
Float	Standard

Figure 34 IP5362_AACC_BZ application circuit

BOM list

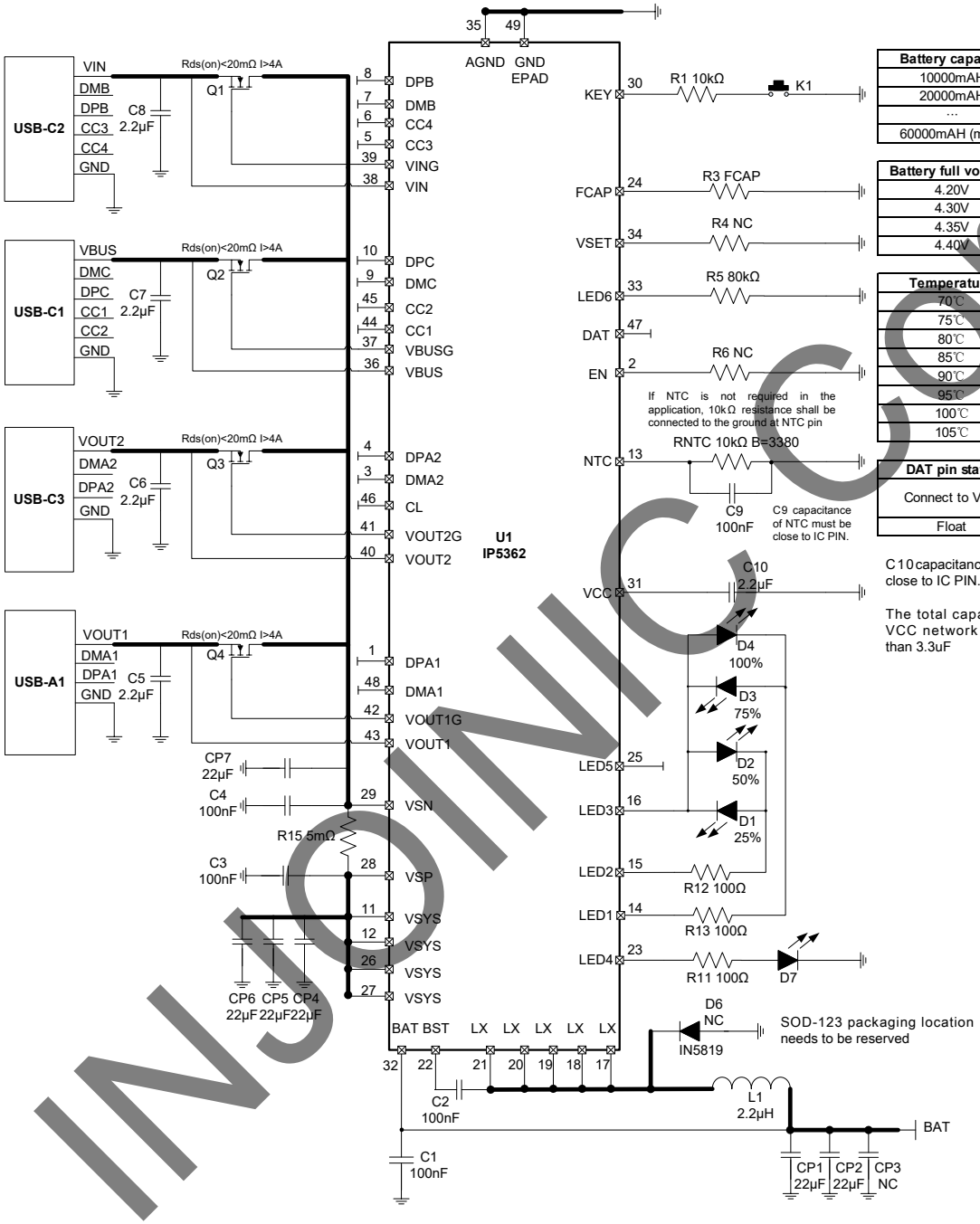
Recommended inductance model：

DARFON PIN	Thickness (mm)	Inductance (uH)	Tolerance	DC Resistance (mΩ)		Heat Rating Current DC Amp.	Saturation Current DC Amps.	Measuring Condition
				Typ.	Max.	Idc(A)Max.	Isat(A)Max.	
SPM70702R2MESQ	5	2.2	±20%	9	10.2	10.5	13.5	100kHz/1.0V
SPM10102R2MESN	4	2.2	±20%	6	7	12	18	100kHz/1.0V
SHC1004-2R2M	4	2.2	±20%	7	9	12	24	

No.	Part Name	Type	Location	Num	Note
1	SMT IC	QFN48 IP5362	U1	1	
2	SMT capacitor	0805 22μF 10% 25V	CP1 CP2	2	
3	SMT capacitor	0805 22μF 10% 25V	CP3	1	NC
4	SMT capacitor	0805 22μF 10% 25V	CP4 CP5 CP6 CP7	4	
5	SMT capacitor	0603 100nF 10% 25V	C1	1	
6	SMT capacitor	0603 100nF 10% 25V	C2	1	
7	SMT capacitor	0603 100nF 10% 25V	C3 C4	2	
8	SMT capacitor	0603 2.2μF 10% 25V	C5 C6 C7 C8	4	
9	SMT capacitor	0603 100nF 10% 25V	C9	1	
10	SMT capacitor	0603 2.2μF 10% 25V	C10	1	
11	SMT resistor	0603 10kΩ 1%	R1	1	
12	SMT resistor	0603 1%	R3	1	R_{FCAP}
13	SMT resistor	0603 1%	R4	1	R_{VSET}
14	SMT resistor	0603 1%	R5	1	R_{TLP}
15	SMT resistor	0603 1%	R6	1	NC
16	SMT resistor	0603 100Ω 1%	R7 R8 R9 R10 R11	5	
17	SMT resistor	0603 100Ω 1%	R12 R13	2	
18	SMT resistor	0603 1kΩ 1%	R14	1	
19	SMT resistor	1206 5mR 1%	R15	1	Sampling resistor PPM＜75
20	NTC THERMAL RESISTOR	10 kΩ@25℃ B=3380	RNTC	1	RNTC
21	SMT LED	0603	D1 D2 D3 D4	4	Choose one of two
22	Nixie tube	YFTD2715AWPG-5D	SMG	1	
23	SMT Schottky	IN5819	D6	1	NC
24	Inductor	2.2μH 10*10	L1	1	
25	KEY	SMT 3*6	KEY	1	
26	USB C	USB C CONNECTOR	USB-C1 USB-C2	2	
27	USB A	AF10 8 USB	USB-A1 USB-A2	2	
28	8205S	SOT-23-6	Q1 Q2 Q3 Q4	4	Rds(on)<10mR>=4A

14.4. IP5362_AACC_LBZ application

The IP5362_AACC_LBZ solution supports 2 USB-A fast charging outputs and 2 Type-C fast charging inputs and outputs.



Battery capacity	R3*0.632(mAH)
10000mAH	15.8kΩ
20000mAH	31.6kΩ
...	...
60000mAH (max)	94.8kΩ

Battery full voltage	R4
4.20V	NC
4.30V	62kΩ
4.35V	33kΩ
4.40V	10kΩ

Temperature	R5
70℃	10k
75℃	25k
80℃	45k
85℃	60k
90℃	80k
95℃	95k
100℃	115k
105℃	130k

DAT pin status	Mode
Connect to VCC	Output normally open for 2 hours
Float	Standard

C10 capacitance of VCC must be close to IC PIN.

The total capacity value on the VCC network needs to be less than 3.3uF

Figure 35 IP5362_AACC_LBZ application circuit

BOM list

Recommended inductance model：

DARFON PIN	Thickness (mm)	Inductance (uH)	Tolerance	DC Resistance (mΩ)		Heat Rating Current DC Amp.	Saturation Current DC Amps.	Measuring Condition
				Typ.	Max.	Idc(A)Max.	Isat(A)Max.	
SPM70702R2MESQ	5	2.2	±20%	9	10.2	10.5	13.5	100kHz/1.0V
SPM10102R2MESN	4	2.2	±20%	6	7	12	18	100kHz/1.0V
SHC1004-2R2M	4	2.2	±20%	7	9	12	24	

No.	Part Name	Type	Location	Num	Note
1	SMT IC	QFN48 IP5362	U1	1	
2	SMT capacitor	0805 22μF 10% 25V	CP1 CP2	2	
3	SMT capacitor	0805 22μF 10% 25V	CP3	1	NC
4	SMT capacitor	0805 22μF 10% 25V	CP4 CP5 CP6 CP7	4	
5	SMT capacitor	0603 100nF 10% 25V	C1	1	
6	SMT capacitor	0603 100nF 10% 25V	C2	1	
7	SMT capacitor	0603 100nF 10% 25V	C3 C4	2	
8	SMT capacitor	0603 2.2μF 10% 25V	C5 C6 C7 C8	4	
9	SMT capacitor	0603 100nF 10% 25V	C9	1	
10	SMT capacitor	0603 2.2μF 10% 25V	C10	1	
11	SMT resistor	0603 10kΩ 1%	R1	1	
12	SMT resistor	0603 1%	R3	1	R_{FCAP}
13	SMT resistor	0603 1%	R4	1	R_{VSET}
14	SMT resistor	0603 1%	R5	1	R_{TLP}
15	SMT resistor	0603 1%	R6	1	NC
16	SMT resistor	0603 100Ω 1%	R11 R12 R13	2	
17	SMT resistor	1206 5mR 1%	R15	1	Sampling resistor PPM＜75
18	NTC THERMAL RESISTOR	10 kΩ@25℃ B=3380	RNTC	1	RNTC
19	SMT LED	0603	D1 D2 D3 D4	4	
20	SMT LED	0603	D7	1	Fast charging light
21	SMT Schottky	IN5819	D6	1	NC
22	Inductor	2.2μH 10*10	L1	1	
23	KEY	SMT 3*6	KEY	1	
24	USB C	USB C CONNECTOR	USB-C1 USB-C2	2	
25	USB A	AF10 8 USB	USB-A1 USB-A2	2	
26	8205S	SOT-23-6	Q1 Q2 Q3 Q4	4	Rds(on)<10mR>=4A

15. Package

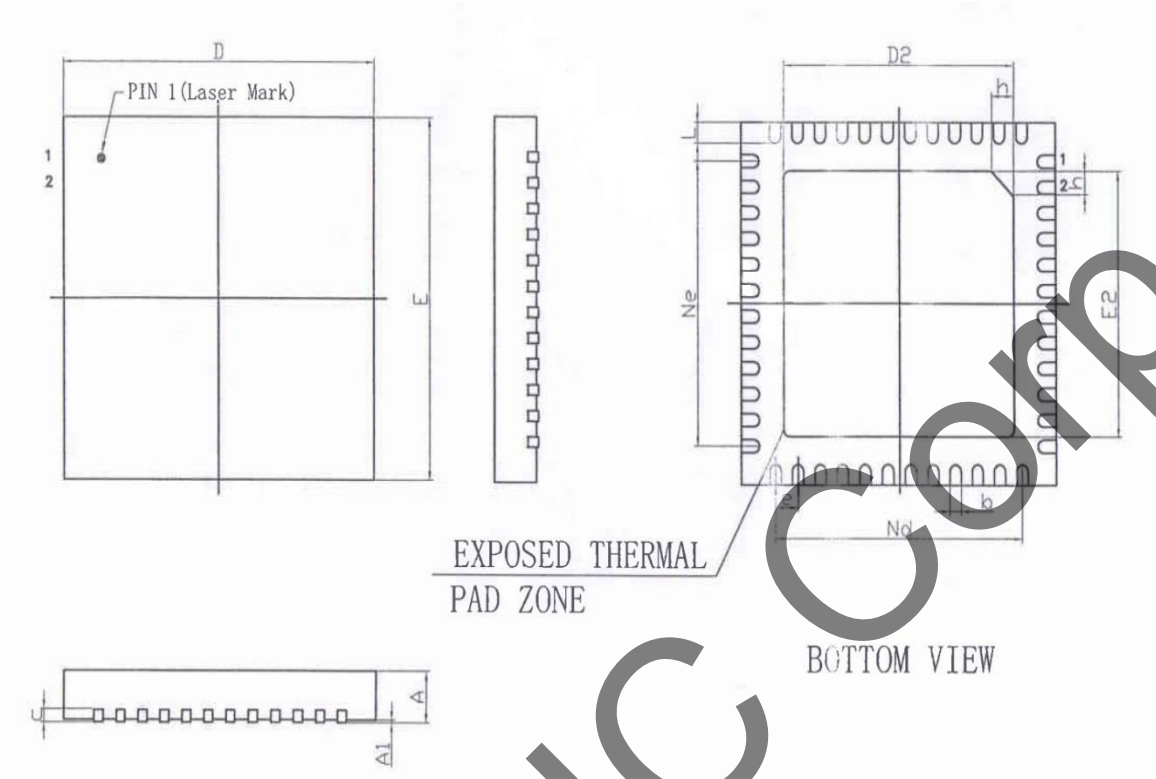


Figure 36 IP5362 Package size

Chart 19 Packaging information size

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.85	0.90	0.95
A1	0	0.02	0.05
b	0.15	0.20	0.25
c	0.18	0.20	0.23
D	5.90	6.00	6.10
D2	4.10	4.20	4.30
e	0.40BCS		
Ne	4.40BCS		
Nd	4.40BCS		
E	5.90	6.00	6.10
E2	4.10	4.20	4.30
L	0.35	0.40	0.45
h	0.30	0.35	0.40
L/F Carrier size (MIL)	177*177		

16. IC Silk Screen Description

Note：
1、 --Injoinic Logo
2、IP5362 --Part Nmuber
3、XXXXXXXX --Manufacture lot Number
4、 ○ --PIN1 location

Figure 37 IP5362 Silk Screen Description

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