Support SCP、Bi-directional PD3.0 and Fast Charge protocol Power Bank SOC

1. Features

- **Support multiple ports simultaneously**
  - ✧ 2USB A output ports, 1 USB B input port
  - ✧ 1 USB C input / output port
  - ✧ 1 lightning input port
  - ✧ Support 1 USB C input / output port + 1 USB C output port (customize)
- **Fast charge**
  - ✧ Every port support fast charge
  - ✧ Support QC2.0 / QC3.0 output
  - ✧ Support FCP / AFC / SFCP input / output
  - ✧ Support low / high voltage SCP output
  - ✧ Support MTK PE1.1&2.0 output
  - ✧ Support USB C DRP input / output
  - ✧ Support BC1.2 / Apple / Samsung
  - ✧ Integrate communication of lightning input
- **Integrated USB PD2.0 / PD3.0 protocol**
  - ✧ Support PD2.0 input / output protocol
  - ✧ Support PD3.0 input / output and PPS output protocol
  - ✧ Support 5V、9V、12V voltage input / output
  - ✧ PPS support 5~11V adjustable voltage with 20mV / Step
- **Charger**
  - ✧ Support 18W charging power, Up to 5A charging current at battery port
  - ✧ Adaptive charging current adjustment
  - ✧ Support 4.20V、4.30V、4.35V、4.40Vbattery
- **Boost**
  - ✧ Output current:
  - ✧ 5V@3.1A 9V@2.22A 12V@1.67A
  - ✧ Up to 95%@5V@2A efficiency with synchronous switching
  - ✧ Support line compensate
- **Battery level display**
  - ✧ Integrated 14bit ADC and coulometer
  - ✧ Support 1/2 /4 LED battery level indicator
  - ✧ Support 88/188 nixie tube
  - ✧ Auto recognition of LED number
- **Others**
  - ✧ Support auto detect of plug in and out
  - ✧ Fast charge status indicator
  - ✧ Support Battery NTC
  - ✧ Enter standby mode automatically in light load
  - ✧ Integrated torch-light driver
  - ✧ Support I2C interface
- **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: 6mm × 6mm 0.5pitch QFN40**

2. Applications

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

3. Description

IP5356 is a power management SOC. It integrates QC2.0/ QC3.0/SCP output fast charging protocol, FCP/ AFC / SFCP input and output fast charging protocol, MTK PE + 1.1 & 2.0 output fast charging protocol, USB C/PD2.0/PD3.0 input and output protocol, USB C PD3.0 PPS output protocol, and BC1.2/Apple/ Samsung mobile phone charging protocol. It integrates the functions of synchronous up / down converter, lithium battery charging management, battery power indication, etc. to provide a complete power solution for fast charging mobile power bank. Two USB A ports, one USB B port and one USB C port can be connected at the same time,any single USB port can support fast charging. When two or more output ports are used at the same time, only 5V is supported.

Only one inductor is needed to realize the function of buck and boost, and only a few peripheral devices are needed in the application, which effectively reduces the size of the overall PCB and reduces the cost of BOM.

The synchronous switch boost system of IP5356 can provide the maximum output capacity of 22.5W. When boost has no load, it will automatically enter the sleep mode.

IP5356 charger provides 18W charging power and charging current up to 5.0A. Built in IC temperature, battery temperature and input voltage control loop, intelligent regulation of charging current.

IP5356 integrates a 14bit ADC and current sensing circuit, which can accurately measure battery voltage and current. The algorithm of remaining battery capacity of IP5356 can accurately obtain battery level information. The battery capacity can be seted to accurately display the remaining battery capacity.

IP5356 supports1/2/4LED battery level indicator, and 88/188 digital tube battery level indicator. IP5356 supports lightning function and supports buttons.

IP5356 supports I2C control interface.

Contents

4. Reversion History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Change to Reversion V1.00 (September 2020)	Page
● Preliminary release	1

Changes from Reversion 1.00 to Reversion V1.40 (March 2022)	Page
● Correction error description,Update part of the parameter description	1
● Chapter 13 Typical Application Principles Updated	34

Changes from Reversion 1.40 to Reversion V1.41 (June 2022)	Page
● Correction error description,Update part description	1

Changes from Reversion 1.41 to Reversion V1.42 (April 2023)	Page
● Updated the description of common customized models	10

Changes from Reversion 1.42 to Reversion V1.43 (March 2024)	Page
● Updated the IP series model selection table	9
● Added common custom model types	10
● Fixed 1 LED mode Charge and discharge display mode	26

5. Typical Application

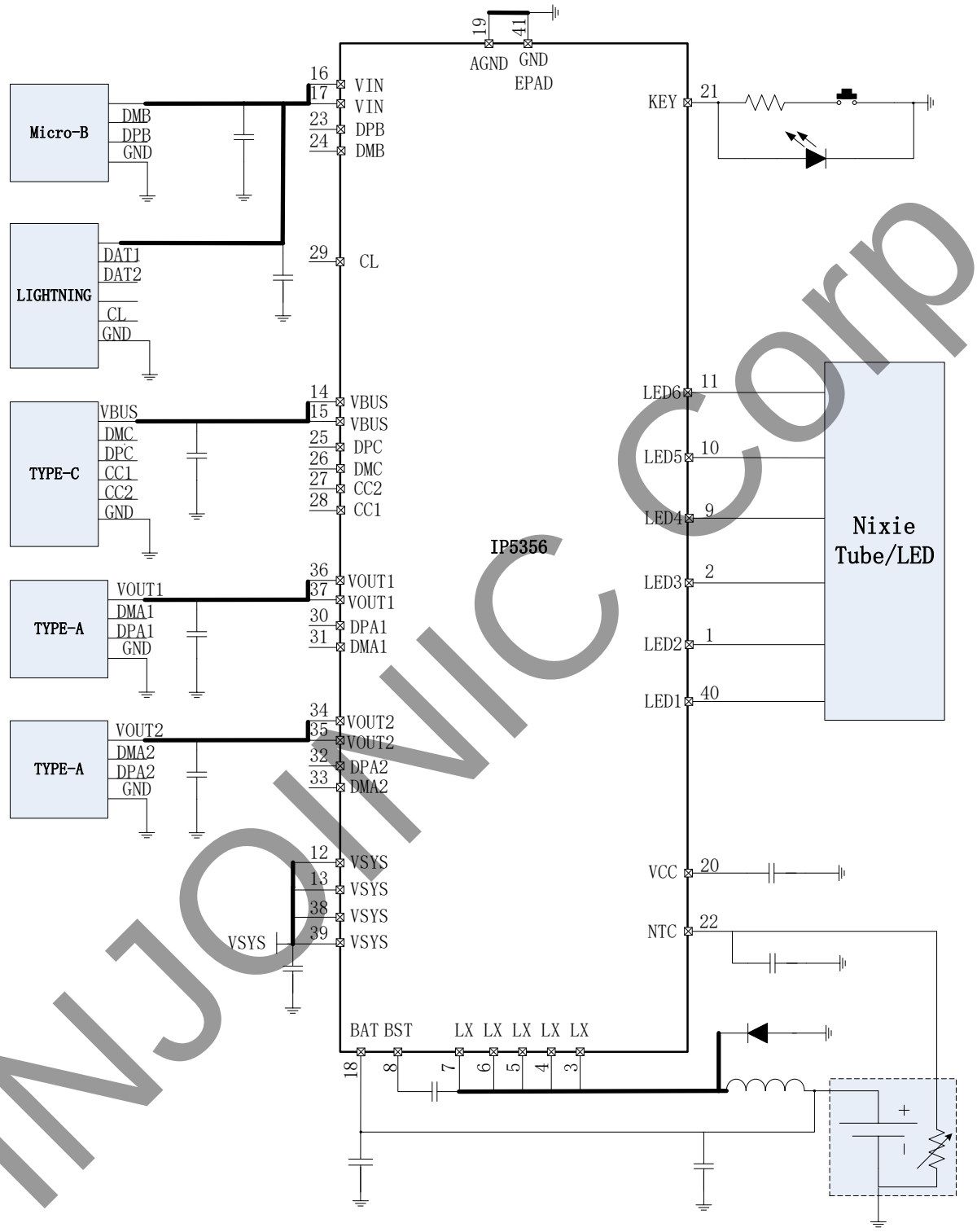


Figure 1 Simplified Application

6. Pin Configuration and Functions

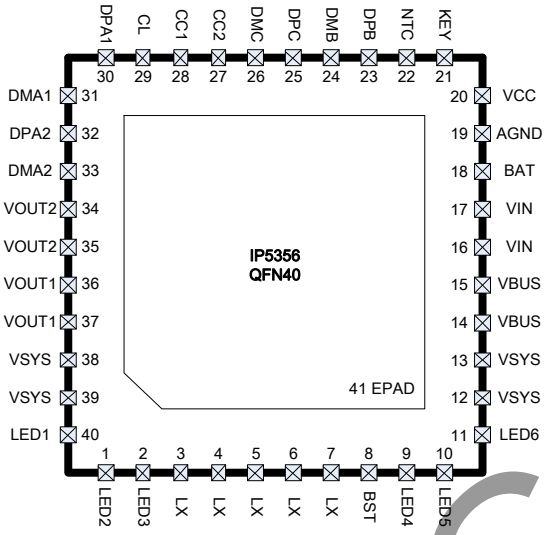


Figure 2 IP5356 40-Pin Top View

6.1. IP5356 Pin Functions

Pin Num	Pin Name	DESCRIPTION
1	LED2	Battery level display drive pin LED2; I2C SDA
2	LED3	Battery level display drive pin LED3; (I2C int functions are only used in LED mode, but not in nixie tube mode.)
3、4、5、6、7	LX	DCDC switch node, connect to inductor
8	BST	Internal high voltage drive, serial capacitor to LX
9	LED4	Battery level display drive pin LED4
10	LED5	Battery level display drive pin LED5 or FCAP external setting pin (Only one function can be selected and set at the factory)
11	LED6	Battery level display drive pin LED6 or Fast charge status indicator drive pin or lightning input decryption or FCAP external setting pin (Only one function can be selected and set at the factory)
12、13、38、39	VSYS	Public Node of system power input and output
14、15	VBUS	USB typec port power pin
16、17	VIN	VIN power pin
18	BAT	Battery supply pin
19	AGND	Analog ground
20	VCC	3.3V Voltage output pin
21	KEY	Key detect pin, reused as WLED torch light function.
22	NTC	NTC PIN

23	DPB	VIN DP pin
24	DMB	VIN DM pin
25	DPC	USB typec port DP pin
26	DMC	USB typec port DM pin
27	CC2	USB typec cc2 pin
28	CC1	USB typec cc1 pin
29	CL	CC signal of lightning input port, connecting the 8th pin of Apple lightning input port
30	DPA1	VOUT1 port DP pin
31	DMA1	VOUT1 port DM pin
32	DPA2	VOUT2 port DP pin
33	DMA2	VOUT2 port DM pin
34、35	VOUT2	VOUT2 output port power pin
36、37	VOUT1	VOUT1 output port power pin
40	LED1	Battery level display drive pin LED1; I2C SCK
41(EPAD)	GND	GROUND

7. IP Series Products List

7.1. 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	√	√	Double Lines	√	√	√	√	QFN48	
IP5358	22.5W	18W	Nixie Tube	-	√	√	√	√	√	-	QFN48	
IP5568	22.5W	18W	Nixie Tube	-	√	√	√	√	√	-	QFN64	
IP5568U	22.5W	18W	Nixie Tube	-	√	√	√	√	√	-	QFN64	
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	

7.2. IP5356 Common Customized Model Description

IC Part No.	battery level display	Fast charge status indicator	Battery capacity setting	VSET	communication of lightning input	Other PD functions		Note
						CL INPUT PD	CL OUTPUT PD	
IP5356_LED_BZ_Suffix	LED	LED6	LED5	4.2V	-	√	-	
IP5356_188_BZ_Suffix	188	-	LED6	4.2V	-	√	-	
IP5356_188_BZ_4V35_Suffix	188	-	LED6	4.35V	-	√	-	
IP5356_188_BZ_4V4_Suffix	188	-	LED6	4.4V	-	√	-	
IP5356_LED_CL_Suffix	LED	LED4	LED5	4.2V	LED6	√	-	
IP5356_188_CL_1W_Suffix	188	-	10000mAH (Internal setting)	4.2V	LED6	√	-	
IP5356_188_CL_1W_4V35_Suffix	188	-	10000mAH (Internal setting)	4.35V	LED6	√	-	
IP5356_188_CL_2W_Suffix	188	-	20000mAH (Internal setting)	4.2V	LED6	√	-	
IP5356_188_CL_2W_4V35_Suffix	188	-	20000mAH (Internal setting)	4.35V	LED6	√	-	
IP5356_188_CL_3W_Suffix	188	-	30000mAH (Internal setting)	4.2V	LED6	√	-	
IP5356_LED_CC_Suffix	LED	LED6	LED5	4.2V	-	-	√	Recommended select C-C cable
IP5356_188_CC_Suffix	188	-	LED6	4.2V	-	-	√	
IP5356_188_CC_4V35_Suffix	188	-	LED6	4.35V	-	-	√	
IP5356_188_CC_4V4_Suffix	188	-	LED6	4.4V	-	-	√	
IP5356_LED_CLL_Suffix	LED	LED4	LED5	4.2V	LED6	-	√	Recommended select C-L cable
IP5356_188_CLL1W_Suffix	188	-	10000mAH (Internal setting)	4.2V	LED6	-	√	
IP5356_188_CLL1W_4V35_Suffix	188	-	10000mAH (Internal setting)	4.35V	LED6	-	√	
IP5356_188_CLL2W_Suffix	188	-	20000mAH (Internal setting)	4.2V	LED6	-	√	
IP5356_188_CLL2W_4V35_Suffix	188	-	20000mAH (Internal setting)	4.35V	LED6	-	√	
IP5356_188_CLO_Suffix	188	-	LED6	4.2V	-	-	√	Recommended select C-L cable
IP5356_188_CLO_4V35_Suffix	188	-	LED6	4.35V	-	-	√	
IP5356_188_CLO_4V4_Suffix	188	-	LED6	4.4V	-	-	√	

Supported : √

not supported : -

8. 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.

9. 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	Vbat	3.0	3.7	4.4	V

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

10. Electrical Characteristics

Unless otherwise specified, TA=25℃, L=2.2uH, VBAT=3.8V

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Charging System						
Input voltage	V_{IN} V_{BUS}		4.5	5 / 9 / 12	14.0	V
Input Over Voltage	V_{IN} V_{BUS}		14	14.5	15	V
Constant Charge Voltage	V_{TRGT}	V_{SET}=4.20V	4.19	4.22	4.25	V
		V_{SET}=4.30V	4.29	4.32	4.35	V
		V_{SET}=4.35V	4.34	4.37	4.39	V
		V_{SET}=4.40V	4.39	4.42	4.45	V
Charge Current	I_{CHRG}	V_{IN} =5V, input current	1.7	2.0	2.3	A
		V_{BUS} =5V, input current	2.2	2.5	2.8	A
		V_{IN} or V_{BUS} >=9V, input power	1.7	2.0	2.3	A
		V_{IN} or V_{BUS} >=12V, input power	1.3	1.5	1.7	A
Trickle Charge Current	I_{TRKL}	V_{IN}=5V,V_{BAT}<1.5V	70	120	170	mA
		V_{IN}=5V, 1.5V<=V_{BAT}<3.0V	100	200	300	mA
Trickle Charge Stop Voltage	V_{TRKL}		2.9	3.0	3.1	V
Charge Stop Current	I_{STOP}	V_{IN}=5V, battery current	250	400	550	mA
Recharge Voltage Threshold	V_{RCH}		4.05	4.10	4.15	V
Charge Safety Time	T_{END}		20	24	27	Hour
Boost System						
Battery operation voltage	V_{BAT}		3.0		4.5	V
Battery input current	I_{BAT}	V_{BAT}=3.7V, V_{OUT}=5.1V, fs=350kHz I_{OUT}=0mA	3	5		mA
DC output voltage	QC2.0 V_{OUT}	V_{OUT}=5V@1A	4.95	5.12	5.23	V
		V_{OUT}=9V@1A	8.70	9.00	9.30	V
		V_{OUT}=12V@1A	11.60	12.00	12.40	V
	QC3.0	@1A	4.95		12.45	V

	V_{OUT}					
	QC3.0 Step			200		mV
Output voltage ripple	ΔV_{OUT}	V_{BAT}=3.7V, V_{OUT}=5.0V, fs=350kHz		100		mV
		V_{BAT}=3.7V, V_{OUT}=9.0V, fs=350kHz		150		mV
		V_{BAT}=3.7V, V_{OUT}=12V, fs=350kHz		200		mV
Boost output current	I_{out}	V_{OUT}=5V		3.1		A
		V_{OUT}=9V		2.0		A
		V_{OUT}=12V		1.5		A
Boost efficiency	η_{out}	V_{BAT}=3.7V, V_{OUT}=5V, I_{OUT}=2A		93		%
		V_{BAT}=3.7V, V_{OUT}=9V, I_{OUT}=2A		92		%
		V_{BAT}=3.7V, V_{OUT}=12V, I_{OUT}=1.5A		91		%
Boost overcurrent shut down threshold	I_{shut}	V_{BAT}=3.7V, V_{OUT}=5V	3.4	4.0	4.4	A
		V_{BAT}=3.7V, V_{OUT}=9V	2.25	2.6	2.9	A
		V_{BAT}=3.7V, V_{OUT}=12V	1.7	1.9	2.2	A
Output light load shutdown current	I_{LOAD}	V_{BAT}=3.7V	50	80	100	mA
Load overcurrent detect time	T_{UVD}	Duration of output voltage under 4.2V, output voltage setting >=5v		30		ms
Load short circuit detect time	T_{OCD}	Duration of output current above 4.4A, output voltage setting >=5v	150		200	μs
Control System						
Switch frequency	fs	Discharge switch frequency	300	350	400	kHz
		Charge switch frequency	450	500	550	kHz
NMOS on resistance	r_{DSON}	Upper NMOS		9	11	mΩ
NMOS on resistance		Lower NMOS		9	11	mΩ
VCC output voltage	V_{CC}	V_{BAT}=3.7V		3.3		V
Battery port standby current	I_{STB}	VIN=0V, VBAT=3.7V, average current		80	350	μA
VCC output current	I_{LDO}	VBAT=3.7V	40	50	60	mA
LED light driving current	I_{WLED}		10	15	20	mA
LED display	I_{LED1}	Voltage decrease 10%		3		mA

driving current	I_{LED2} I_{LED3}					
Total load Light load shut down detect time	$T1_{load}$	The load current is consistently less than 80mA	25	32	44	s
Output port light load shut down detect time	$T2_{load}$	Between VSN and VOUT1(VOUT2 and VBUS) continued lessthan 1.8mV	14	16	18	s
Short press on key wake up time	$T_{OnDebounce}$		60	100	200	ms
Time of WLED turn on	$T_{Keylight}$	Long press key time	1.2	2	3	s
Thermal shut down temperature	T_{OTP}	Rising temperature	130	140	150	℃
Thermal shut down hysteresis	ΔT_{OTP}			40		℃

11. Function Description

11.1. Functional Block Diagram

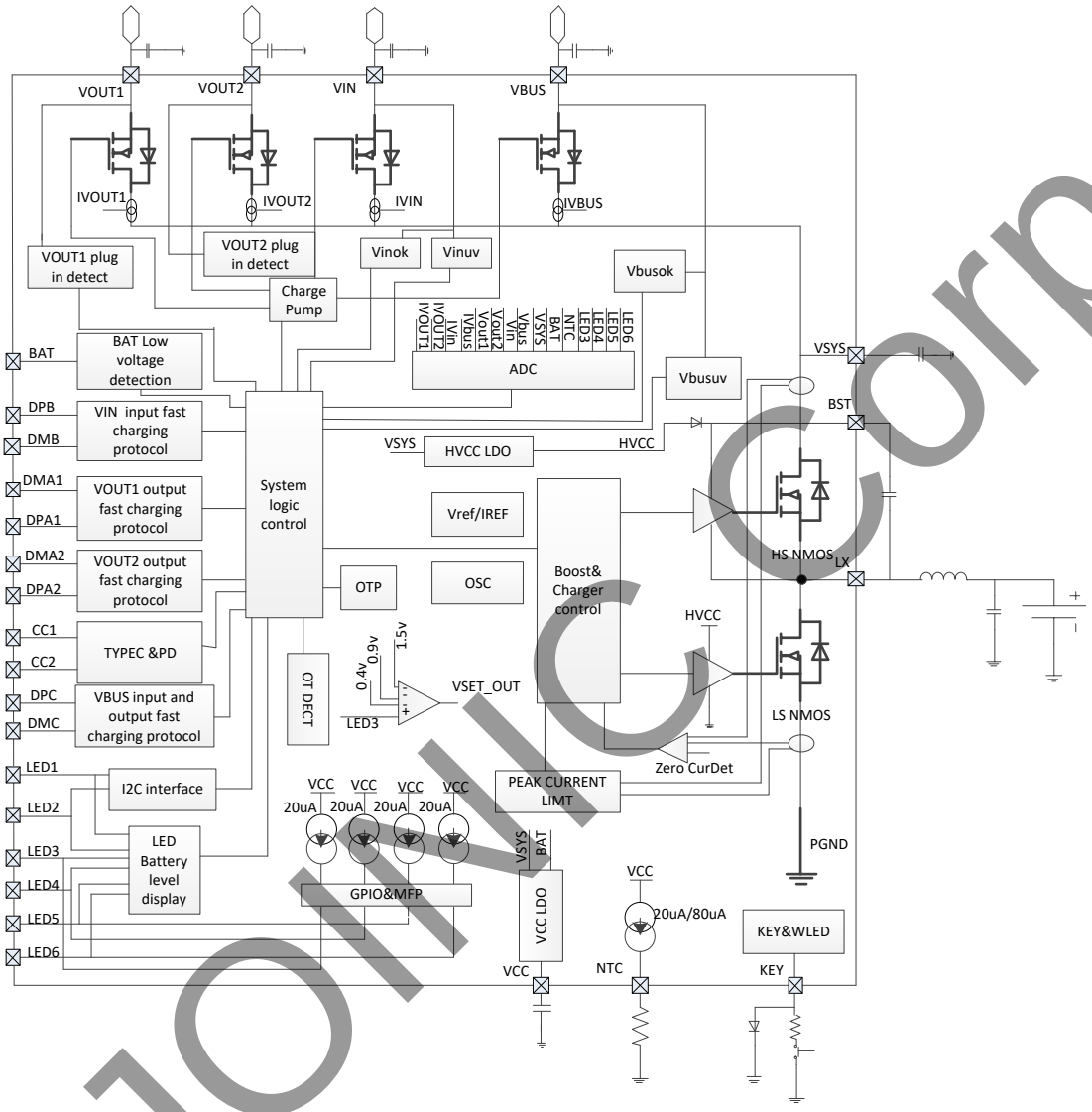


Figure 3 Functional Block Diagram

11.2. Low power lock out and activation

The first time IP5356 access to the battery, whatever the battery voltage, IC is in lock out state, battery level indicator LED will flash 5s, or the digit 0 of the nixie tube flashes 5s for prompt; Under non-charging state, if the battery voltage is too low to trigger the low power shutdown, IP5356 will enter lock out state too.

In low battery state, to decrease the quiescent power, IP5356 do not support plug in detect function or key press activation function. During which, key press action will not trigger boost output, and battery level indicator LED will flash 5s.

Under the lock out state, only by entering charging status can activate IP5356 ‘s full function.

11.3. Charge

IP5356 integrated a constant current and constant voltage Li battery charging management system with synchronous switch, adaptive to various charging voltage.

When the battery voltage is lower than 3V, trickle charging less than 200mA charging current is applied; when the battery voltage is higher than 3V, enters constant current charging stage, the maximum charging current at battery port is 5.0A; when the battery voltage is near the preset battery voltage, enters constant voltage charging stage; when the charging current is less than 400mA and battery voltage is near the constant voltage charging stage, the charging process is stopped. When the charging stage is accomplished, once the battery voltage falls under 4.1V, battery charging stage will be restarted.

IP5356 adopted switch charging technology, switch frequency is 500kHz. During 5V input voltage, maximum input power is 10W; During the fast charging state, maximum input power is 18W. The highest charging current is up to 5.0A, charging efficiency can be up to 94%, such can reduce 3 / 4 charging time.

IP5356 will adjust charge current automatically applicable to adaptors with different load capacity.

IP5356 supports charging the battery and phone at the same time,output voltage is 5v.

11.4. Boost

IP5356 Integrated a synchronized switch converter which supports high voltage output, providing 5V ~ 12V output voltage output, load capacity can be: 5V@3.1A, 9V@2.22A and 12V@1.67A. 350kHz switching frequency. Internal soft start function. In avoid of large rush current causing device failure at start up stage, built-in overcurrent, short circuit, overvoltage and over temperature protection function, make insurance of the stability and reliability of power system.

Boost system output current can be auto-modulated according to the temperature, ensuring the IC is under the preset temperature.

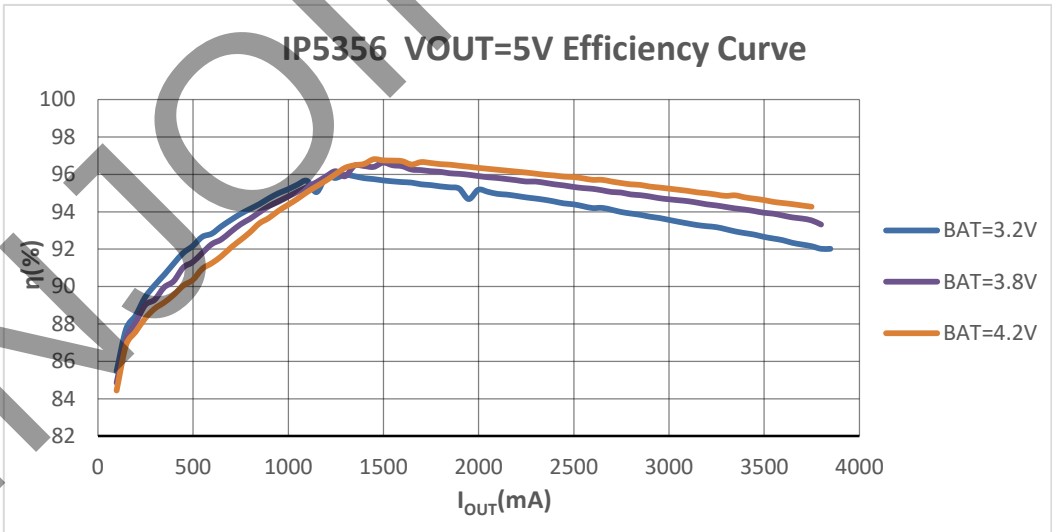


Figure 4 IP5356 VOUT=5V Efficiency Curve

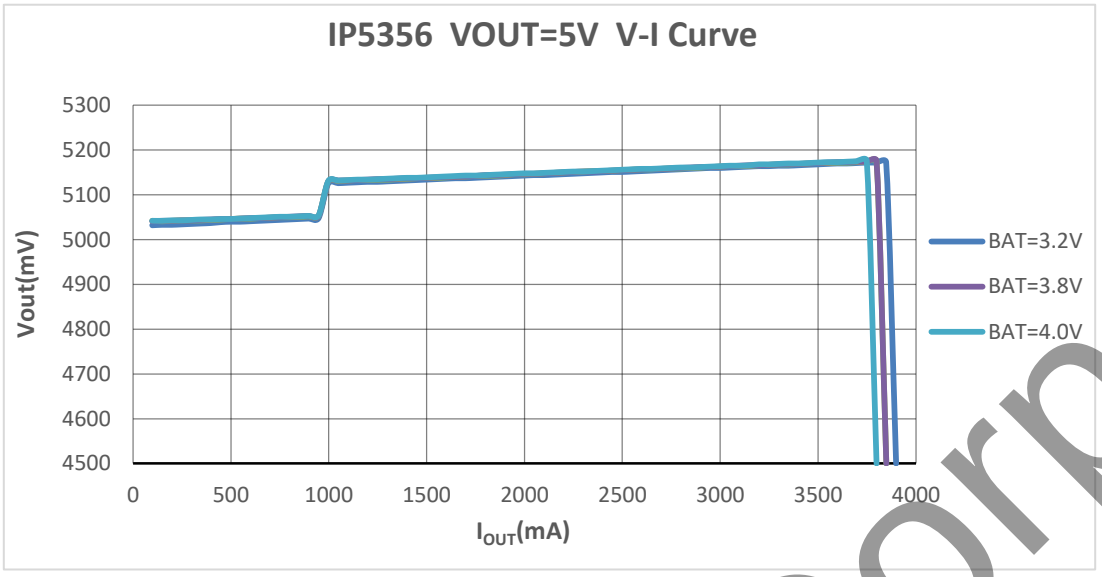


Figure 5 IP5356 VOUT=5V V-I Curve

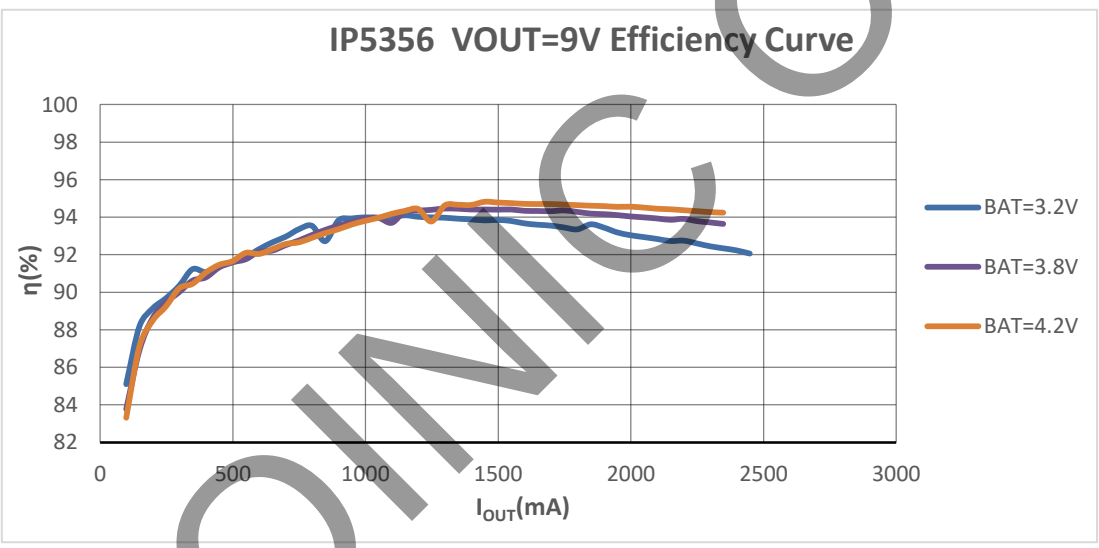


Figure 6 IP5356 VOUT=9V Efficiency Curve

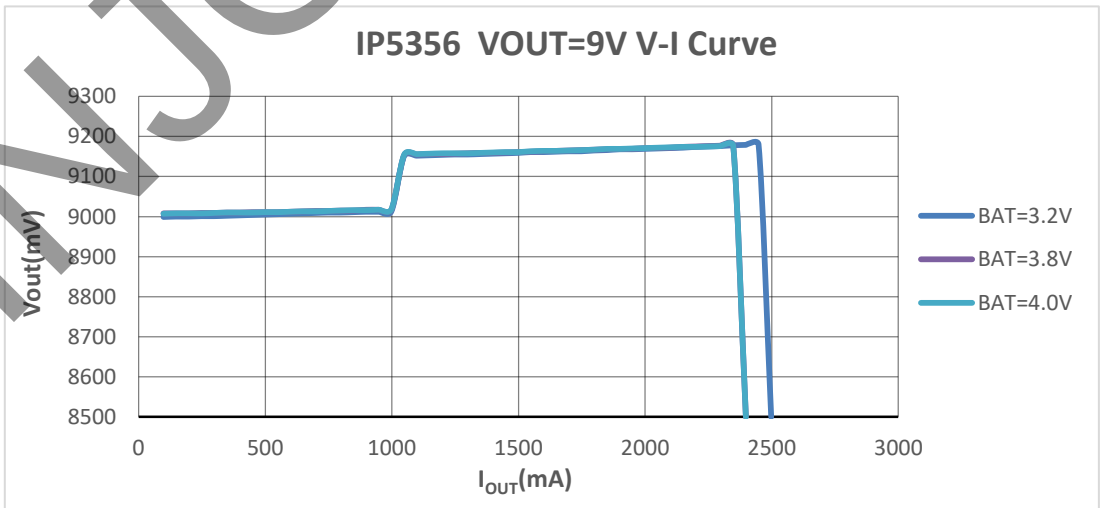


Figure 7 IP5356 VOUT=9V V-I Curve

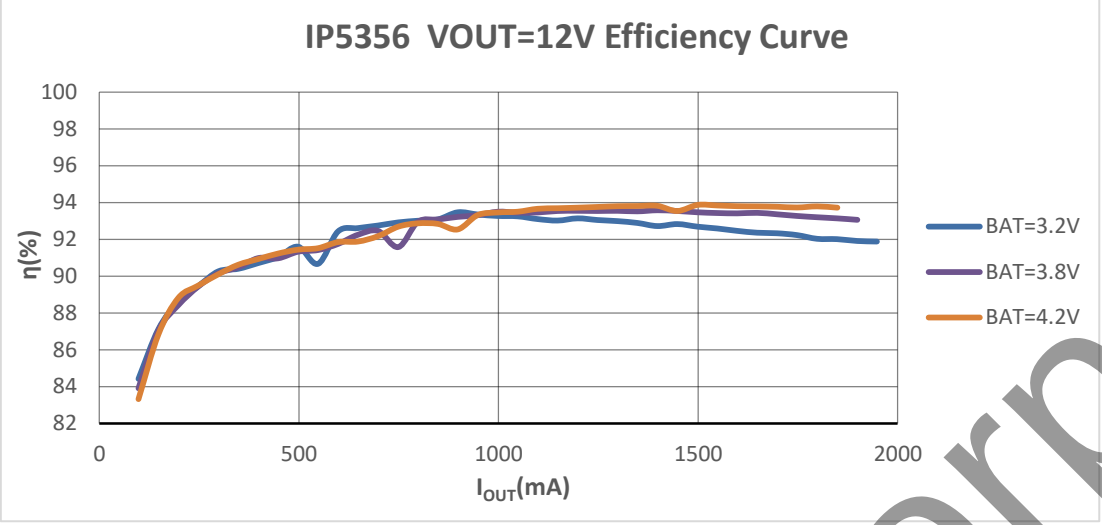


Figure 8 IP5356 VOUT=12V Efficiency Curve

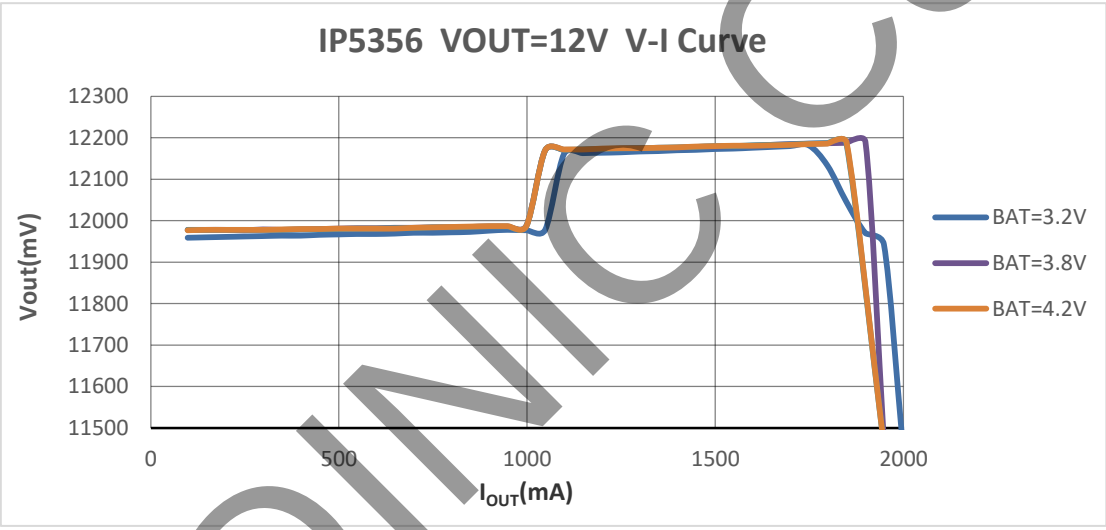


Figure 9 IP5356 VOUT=12V V-I Curve

11.5. USB C

IP5356 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, IP5356 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.

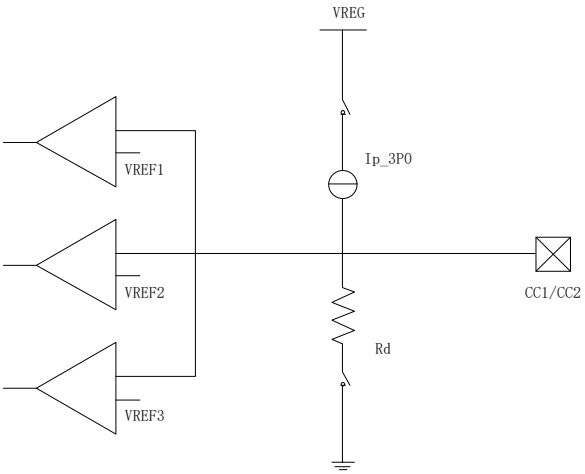


Figure 10 CC internal circuit

Chart 1 Pull-up and pull-down ability

Name	Value
Ip_3P0	330μA
Rd	5.1kΩ

Chart 2 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 3 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 4-36 DRP Timing

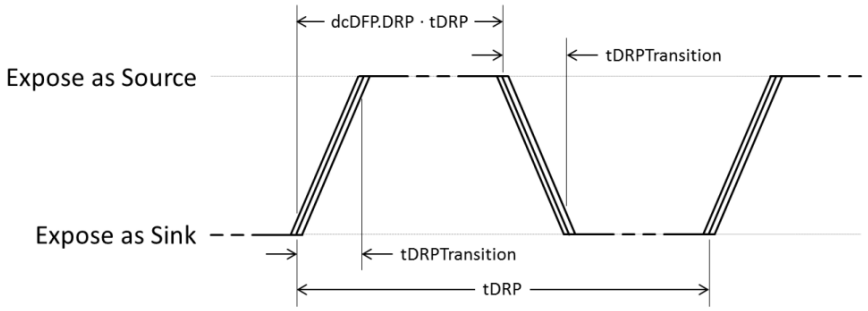


Figure 11 USB C detects cycle

Chart 4 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 4-16 Connection State Diagram: DRP with Accessory and Try.SRC Support

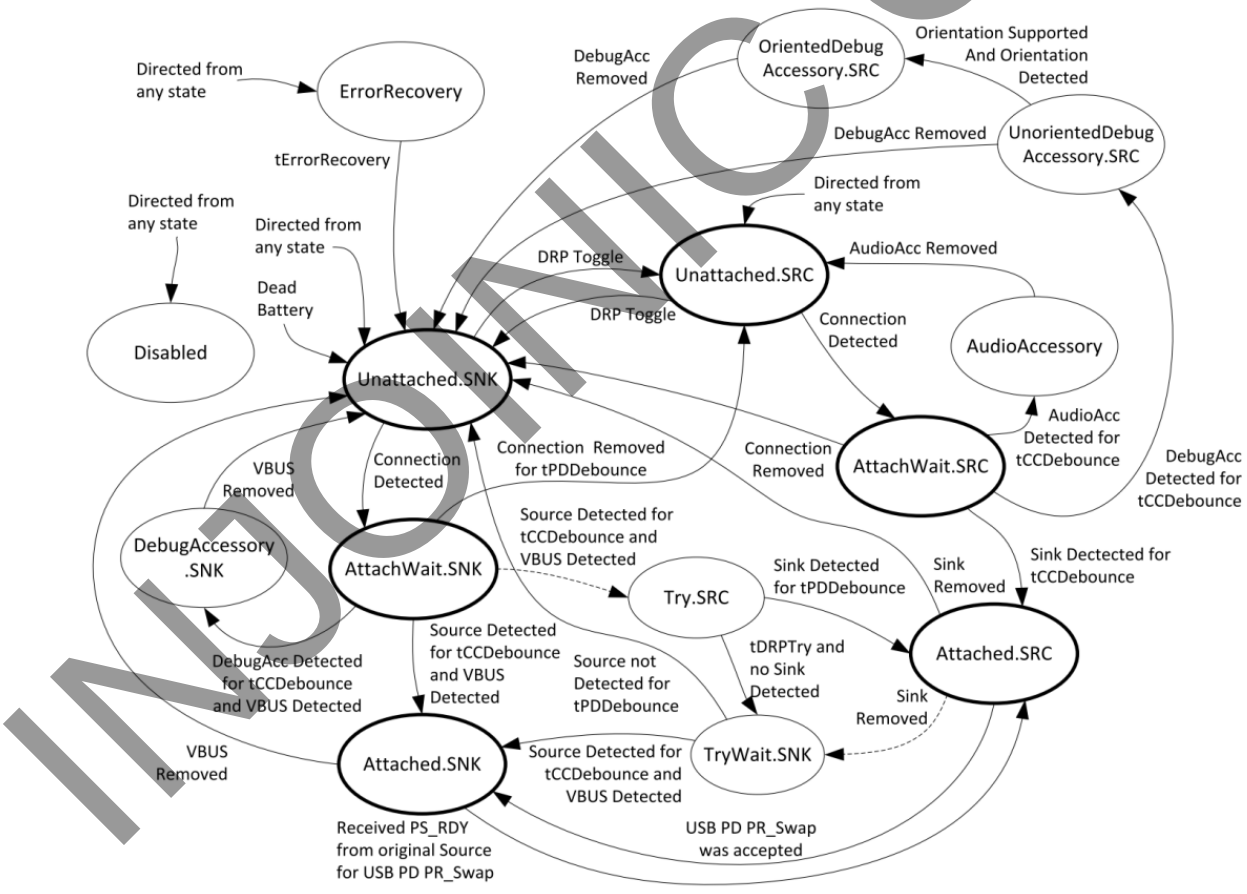


Figure 12 USB C detects state transition

11.6. USB C PD

IP5356 integrated USB C Power Delivery PD2.0/PD3.0 / PPS (Programmable Power Supply) protocol, integrate physical (PHY) layer for data transmitting/receiving across the cc wire, hardware biphase mark coding (BMC) module and hardware CRC protect the data integrity.

Support PD2.0 / PD3.0 bi-directional input/output and PPS output protocol. Input and output voltage support 5V、9V、12V. Output source cap: 5V@2.4A、 9V@2.22A、12V @1.67A、PPS 3.3~11V@2A output voltage adjustable with 20mV / step. Support up to 20W power level.

11.7. Fast Charge Protocol

IP5356 support multi fast charge protocols: PD2.0 / PD3.0 / PPS、QC2.0 / QC3.0、FCP、AFC、SFCP、MTK、Apple、Samsung.

SFCP/MTK protocol is not supported by default in standard products. If necessary, you can apply for the customization of SFCP/MTK protocol.

Input QC2.0/QC3.0/MTK protocol is not support for charging the power bank. External fast charging protocol IC is not supported.

Input fast charge protocol of FCP、AFC、SFCP are supported for charging the power bank.

If the power bank is to charge for the phone, when IP5356 enter discharge mode, it will detect the fast charge type and request on DP, DM, which support fast charge for devices of QC2.0/QC3.0、FCP、AFC、SFCP、MTK、and Apple 2.4A mode, Samsung 2.0A mode and BC1.2 1.0A 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 5 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	Continuous 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 6 Fast charging protocol supported by each port of IP5356

protocols	VOUT1 output	VOUT2 output	VIN input	VBUS output	VBUS input
QC2.0	√	√	-	√	-
QC3.0	√	√	-	√	-

AFC	√	√	√	√	√
FCP	√	√	√	√	√
SFCP	√	√	√	√	√
SCP	√	√	-	√	-
MTK PE1.0	√	√	-	√	-
MTK PE2.0	√	√	-	√	-
PD2.0	-	-	-	√	√
PD3.0	-	-	-	√	√
PPS	-	-	-	√	-

Supported : √

Not Supported : -

11.8. Charge and Discharge Path Management

Standby:

If VIN or VBUS is attached, IP5356 will start the charging process directly.

If USB C UFP device is attached on VBUS or sink device is attached on VOUT port, IP5356 will start discharge function automatically.

If key is pressed, the VOUT1, VOUT2 and USB C port will open only when load is detected on the according port, or the output on these port will be closed.

Discharge:

In the case of no key action, only the output path of the output port plugged in the electrical equipment will be opened; the output path of the output port not connected to the equipment will not be opened. When the output current of the opened output port is less than about 80mA, it will automatically close after a period of time.

Any port of Vout1, Vout2 and USB C can support the output fast charging protocol. However, since this application is a single inductance application, it can only support one voltage output, so it can only support the fast charging output when only one output port is open. When two or three outlets are used at the same time, the quick charge function will be automatically turned off.

According to the connection shown in the "typical application diagram", when any output port has entered the fast charging output mode, when the other output port is plugged in with electrical equipment, all the output ports will be closed first, the high-voltage fast charging function will be closed, and then the output ports with equipment will be opened. In this case, all the output ports only support the charging of apple, Samsung and bc1.2 modes. When the number of electrical equipment is reduced to only one, after 16 seconds, all output ports will be closed first, the high-voltage fast charging function will be turned on, and then the output port of the last electrical equipment will be turned on, so as to reactivate the equipment to request fast charging. When only one output port is open and the total output current is less than about 80mA for about 32S, the output port and discharge function will be closed and the standby mode will be entered.

Charging:

Any port of VIN port and VBUS port can be charged by inserting the power supply. If both ports are connected to the power supply for charging, the first inserted power supply will be used for charging.

In the single charging mode, the fast charging mode of the power supply will be automatically identified, and the appropriate charging voltage and current will be automatically matched

Charging and discharging at the Same Time:

When the charging power supply and the electrical equipment are plugged in at the same time, the charging and discharging mode will be automatically entered. In this mode, the chip will automatically turn off the internal fast charge input request. When the vsys voltage is only 5V, turn on the discharge path to supply power to the electrical equipment; if the vsys voltage is greater than 7.0V, for safety reasons, the discharge path will not be turned on. In order to ensure the normal charging of electrical equipment, IP5356 will increase the charging undervoltage loop to more than 4.9Vto ensure the priority of power supply to electrical equipment.

In the process of charging and discharging, if the charging power is unplugged, IP5356 will turn off the charging function and restart the discharging function to supply power to the electric equipment. For the sake of safety, and in order to be able to reactivate the mobile phone to request fast charging, the voltage will drop to 0V for a period of time during the conversion process.

In the process of charging and discharging, if the electric equipment is unplugged, or the electric equipment is full and stops pumping for 16s, the corresponding discharge path will be automatically closed. When the discharge paths are closed and the state returns to single charging mode, the charging undervoltage loop will be reduced, and the fast charging will be automatically reactivated to accelerate the charging of mobile power supply.

11.9. Automatic detection of mobile phone

Auto detection on sink device / phone attachment:

IP5356 support auto detection on sink device/phone attachment/plug in, once the attachment is detected, the boost will be turned on charging the sink device / phone, so non-key solution are supported.

Auto detection on sink device / phone fully charged:

IP5356 measures the output current of each port through the on-chip ADC. When the output current of a single port is less than about 80mA and lasts for about 16s, the output port will be closed. When the total current is less than about 80mA for about 32s, it is considered that all output cell phones are full or unplugged, and the boost output will be automatically turned off.

11.10. KEY / nixie tube selection

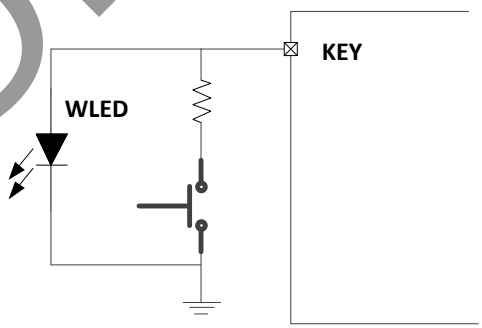


Figure 13 KEY circuit

Key circuit is illustrated in Figure 12, which can recognize short press or long press operation.

- Short press : pressed time in range of 100ms~2s：turn on the battery level display LED and BOOST output
- Long press :pressed time longer than 2s：turn on or turn off the torch light WLED
- No response on press time less than 30ms
- Two short press in 1s: turn off boost output, battery level display LED and torch light WLED
- Long 10s press will reset the whole system

11.11. Fast Charge state indication

LED6 of IP5356_LED series IC is used for indication for the present fast charge mode, either in fast charging or discharging mode, when the system enters fast charge mode and in non-5V mode, the light LED will turn on.

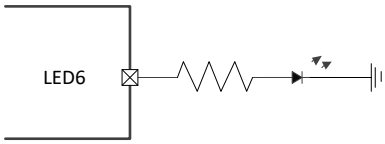


Figure 14 fast charge state indication

If you need LED6 pin as the driver pin of the 6pin nixie tube solution, you need to customize it.

LED6 pin can be used as lightning input decoding pin, fast charging lamp driving pin, FCAP pin for battery capacity setting, and driving pin for 6pin nixie tube scheme. Only one of the above functions can be selected, which can be set at the factory.

11.12. Coulombmeter and battery level display

IP5356 has built-in coulombmeter function, which can realize accurate calculation of the remaining battery capacity.

IP5356 supports 4 LED, 2 LED and 1 LED mode automatic selection.

IP5356 supports 88 / 188 nixie tube to display the remaining battery capacity .

11.12.1. Battery level display for LED mode

IP5356 4LED、3LED、2LED and 1LED battery level display solution, the connection method is as follows.

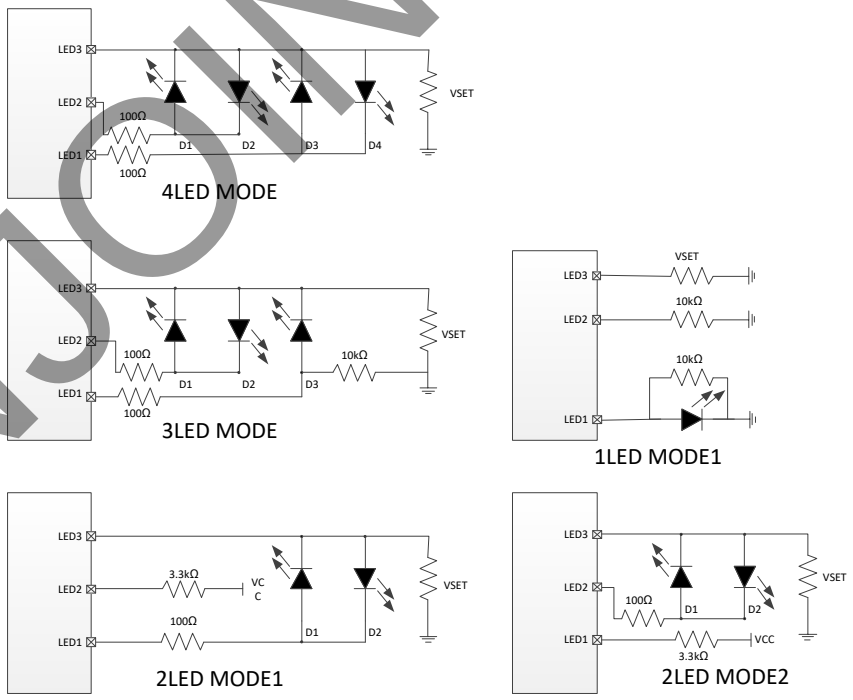


Figure 15 4LED, 3LED, 2LED, 1LED circuits

Chart 7 4LED display mode During charging

Battery capacity (C) (%)	D1	D2	D3	D4
Fully charged	ON	ON	ON	ON
75%≤C	ON	ON	ON	0.5Hz Flash
50%≤C<75%	ON	ON	0.5Hz Flash	OFF
25%≤C<50%	ON	0.5Hz Flash	OFF	OFF
C<25%	0.5Hz Flash	OFF	OFF	OFF

Chart 8 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%	1.0Hz Flash	OFF	OFF	OFF
C=0%	OFF	OFF	OFF	OFF

Chart 9 3LED display mode During charging

Battery capacity (C) (%)	D1	D2	D3
Fully charged	ON	ON	ON
66%≤C	ON	ON	0.5Hz Flash
33%≤C<66%	ON	0.5Hz Flash	OFF
C<25%	0.5Hz Flash	OFF	OFF

Chart 10 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%	1.0Hz Flash	OFF	OFF
C=0%	OFF	OFF	OFF

Chart 11 2 LED display mode 1 is bi-color LED During charging

Battery capacity (C) (%)	D1	D2
Fully charged	OFF	ON
66%≤C<100%	OFF	0.5Hz Flash
33%≤C<66%	0.5Hz Flash	0.5Hz Flash
C<33%	0.5Hz Flash	OFF

Chart 12 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%	1.0Hz Flash	OFF

2 LED mode 2 display:
During charging: D1 LED flash on cycle of 2s (1s on and 1s off), when fully charged, constantly on;
During discharging: D2 LED is constantly on, when voltage lower than 3.2V, flash on cycle of 1s (0.5s on and 0.5s off), when voltage is lower than 3.0V, system is power down.
1 LED mode 1 display:
During charging: LED flash on cycle of 2s (1s on and 1s off), when fully charged, constantly on;
During discharging: LED is constantly on, when voltage lower than 3.2V, flash on cycle of 1s (0.5s on and 0.5s off), when voltage is lower than 3.0V, system is power down.

11.12.2. 188 nixie tube display mode

Chart 13 The 188 nixie tube model IP5356 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% 0.5HZ Flash	constantly on 100%	0 - 5% 1.0Hz Flash	5% -100% constantly on

5pin 188 nixie tube:

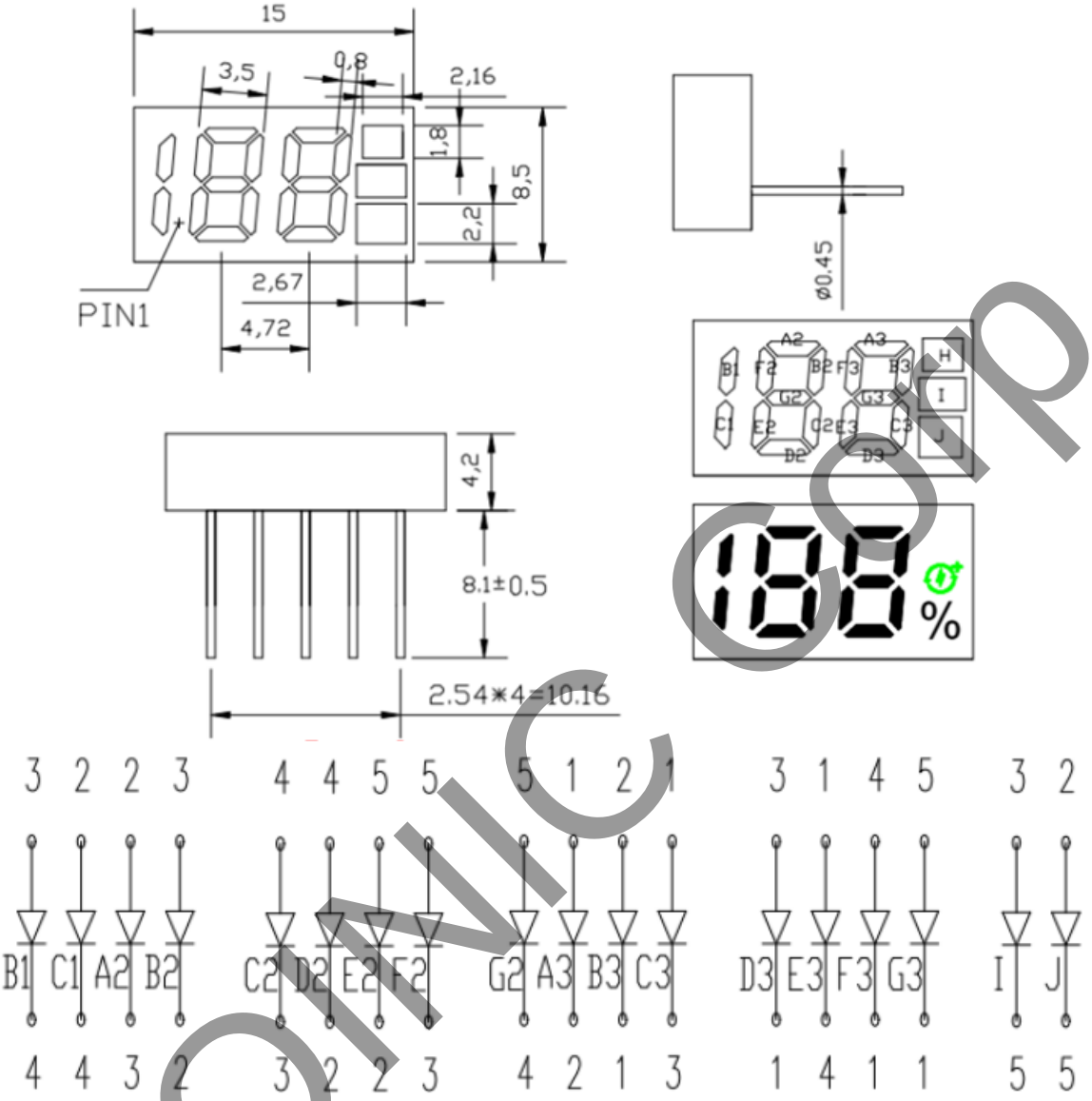


Figure 16 5pin 188 nixie tube circuit

Chart 14 IP5356 Light Drives Drive Pin and Digital Tube Pin Map Relationship

	IP5356 display driver pin	nixie tube pin	note
The sequence mapping relationship between IP5356 display driver pin and nixie tube pin	LED1(40 pin)	1 pin	
	LED2(1 pin)	2 pin	
	LED3(2 pin)	3 pin	
	LED4(9 pin)	4 pin	
	LED5(10 pin)	5 pin	
	HLED(11 pin)	6 pin	choosable, 6 pin nixie tube

11.12.3. Coulombmeter

IP5356 supports the external resistor setting of the initial capacity of thebattery, and uses the integration of the current and time at the port of the battery to manage the remaining capacity of the

battery, which can accurately display the current remaining capacity of the battery.

IP5356 external pin sets the initial battery capacity formula: battery capacity = R13 * 0.448 (mAH). Up to 60000mah.

*For IP5356_LED series IC, Led 5 pin is used to set FCAP capacity.

*For IP5356_188 series IC, Led 6 pin is used to set FCAP capacity.

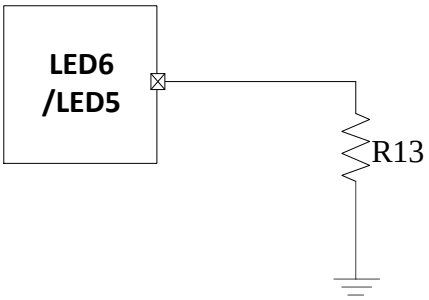


Figure 17 Battery capacity configuration circuit

Chart 15 Typical battery capacity config table

R13 resistance	battery initial capacity (mAh)=R13*0.448 (mAh)
11kΩ	5000 mAh
22kΩ	10000 mAh
33kΩ	15000 mAh
44kΩ	20000 mAh
56kΩ	25000 mAh
66.5kΩ	30000 mAh
90kΩ	40000 mAh
110kΩ	50000 mAh
133kΩ	60000 mAh

11.13. VSET(Battery voltage selection)

IP5356 sets the battery type by outputting 20uA current on Vset pin and connecting different resistance to GND, so as to change the threshold value of battery level display, the constant voltage to charge the battery and the protection voltage. The resistance of Vset external to GND and the set battery type are shown in the table below. Pay attention to 1% precision resistance for external resistance, Resistance selection needs to take into account the Vset voltage as far as possible in the middle of the judgment range.

IP5356_LED_xxxx_F series IC support 4.20V, 4.3v, 4.35v and 4.40v batteries for LED3 pin. By setting the type of battery through Vset (LED3) pin, the threshold value of power display, the constant voltage of charging battery and the protection voltage are changed. The Vset resistance values and battery type are shown in the table below.

Chart 16 Battery voltage selection config table

VSET pin external resistance to GND	Battery full voltage selection
NC	4.2V
62kΩ	4.3V
33kΩ	4.35V
10kΩ	4.4V

*The default configuration of IP5356_188 series is 4.2V battery, and 4.3V, 4.35V and 4.40V need to be customized.

11.14. NTC function

IP5356 integrates NTC function, which can detect battery temperature. When IP5356 is working, NTC1 pin output 20uA current, and generate voltage through external NTC resistance. IC internal detects the voltage of NTC pin to determine the current battery temperature.

* The 100nF capacitance of NTC must be close to IC PIN.

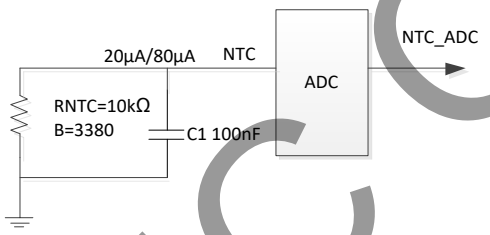


Figure 18 NTC circuit

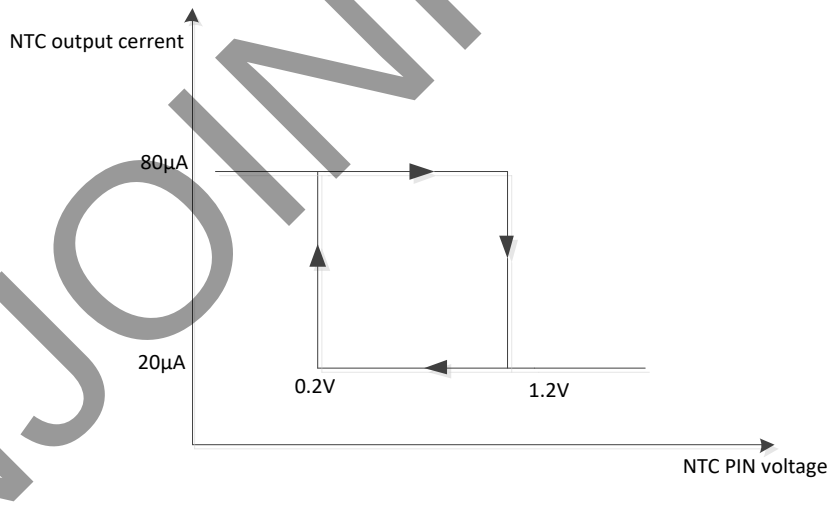


Figure 19 Relationship between NTC voltage and output current

In order to distinguish the temperature between high temperature and low temperature, NTC emits 80μA current at high temperature and 20μA current at low temperature. When the NTC discharge current is 80μA, if the NTC voltage is higher than 1200mV, the current becomes 20μA; when the NTC discharge current is 20μA, if the NTC voltage is lower than 200mV, the current changes to 80μA.

In the state of charge:

When the NTC voltage is lower than 0.38V, it means the battery temperature is higher than 45℃，the charging is stopped.

When the NTC voltage is higher than 0.55V, it means the battery temperature is lower than 0℃，the charging is stopped.

In the state of discharge:

When the NTC voltage is lower than 0.23V, it means the battery temperature is higher than 60℃，the discharging is stopped.

When the NTC voltage is higher than 1.38V, it means the battery temperature is lower than -20℃，the discharging is stopped.

If NTC is not required in the application, 10kΩ resistance shall be connected to the ground at NTC pin, and floating or direct grounding is not allowed.

11.15. VCC

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

11.16. I2C

I2C connection mode

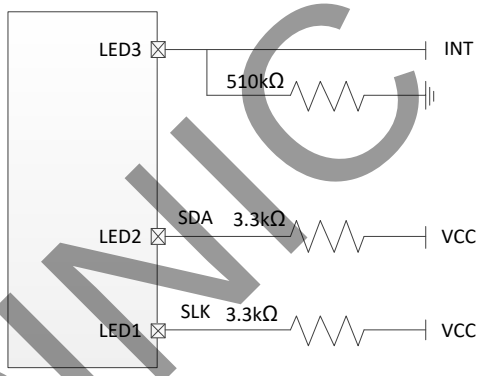


Figure20 IIC Application method

IP5356_LED_CL series supports I2C connection. According to the corresponding connection mode, IC will automatically enter ot close IIC mode. In I2C mode, the INT signal is in high resistance state in standby mode and high level state in working state, which can be used to wake up MCU.

11.17. Dual USB C Application

IP5356 customized scheme can support MICRO-B fast charging input, TYPE-C fast charging input and output, TYPE-C fast charging output and USB-A fast charging output, realizing the dual TYPE-C port scheme. Fast charging specifications such as standard.

Custom model IP5356_LED_CC supports LED light scheme. Refer to “IP5356" for schematic diagram_LED_CC LED lamp application "

Custom model IP5356_188_CC supports nixie tube scheme. Refer to "IP5356" for schematic diagram_188_CC digital tube application "

12. 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.

12.1. Location of VOUT1 / VOUT2 / VBUS capacitor

IP5356 integrates USB output power path. The 2.2μF capacitor of VOUT1 / VOUT2 / VBUS must be close to the IC pin. If the layout allows, the position of the 2.2μF capacitor should be as close as possible to the chip.

At the same time, a 100nF capacitor is placed near the USB connector, and the capacitance is parallel to the USB connector.

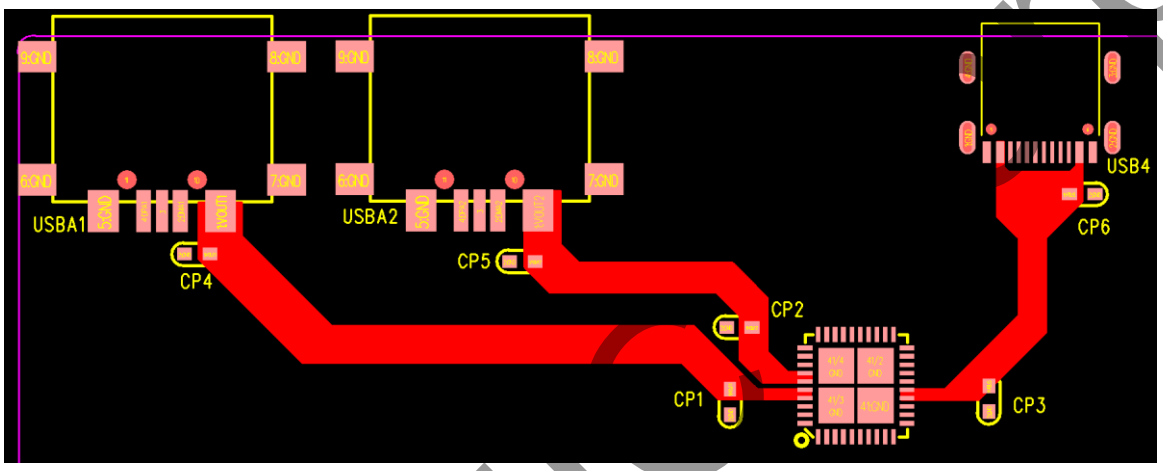


Figure21 Location of VOUT1 / VOUT2 / VBUS capacitor

12.2. Location of VSYS capacitor

The power and current of the chip are relatively large, and the position of the capacitor on the vsys network will affect the stability of the DCDC. The capacitors on the vsys network need to be as close to the vsys pin and EPAD of the IC as possible, and copper is laid on a large area, and more vias are added to reduce the area of current loop between the capacitors and the IC and reduce parasitic parameters.

Vsys pins are distributed on both sides of the chip, and capacitors need to be placed near the pins on both sides, and the vsys pins on both sides are connected by a wide (no less than 100mil) copper laying on the PCB.

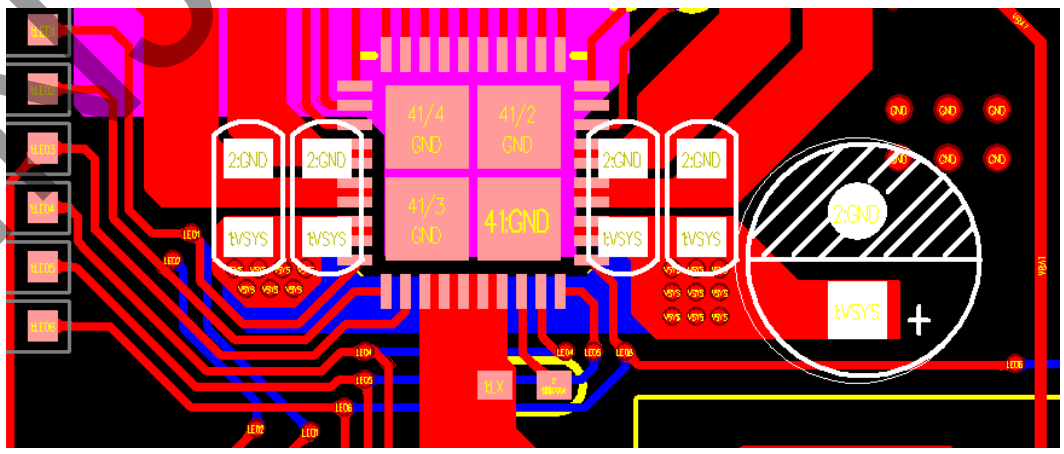


Figure22 Location of VSYS capacitor

12.3. Location of BAT/VCC capacitor

The filter capacitors of bat pin and VCC pin should be placed as close as possible to the pin of the chip, and some holes should be drilled near the capacitors GND pin.

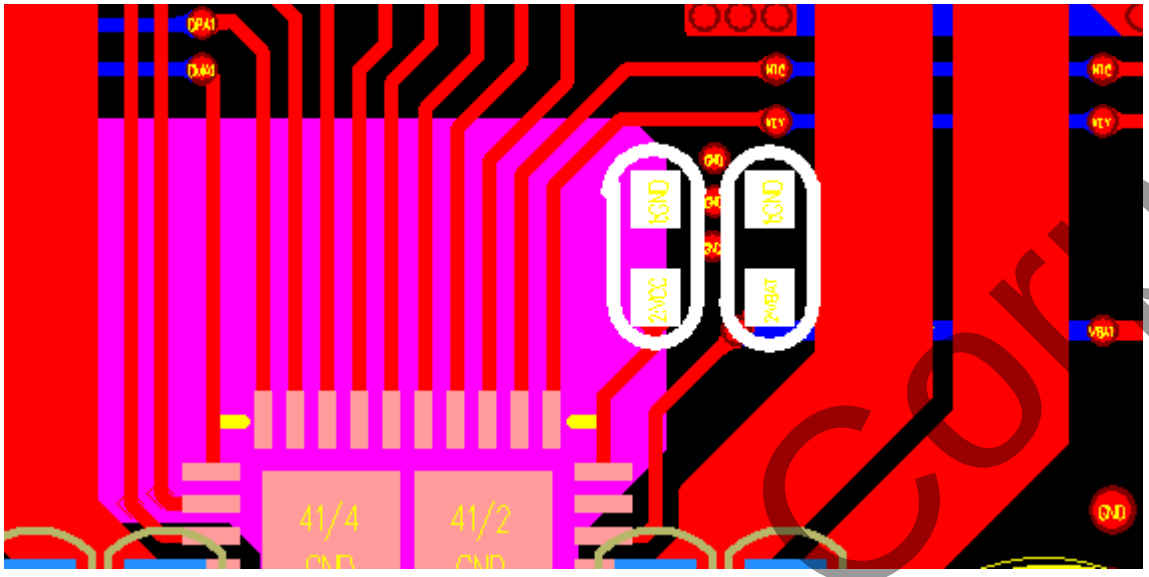


Figure23 Location of BAT/VCC capacitor

12.4. Location of NTC capacitor

The 100nF capacitance of NTC must be close to IC PIN.

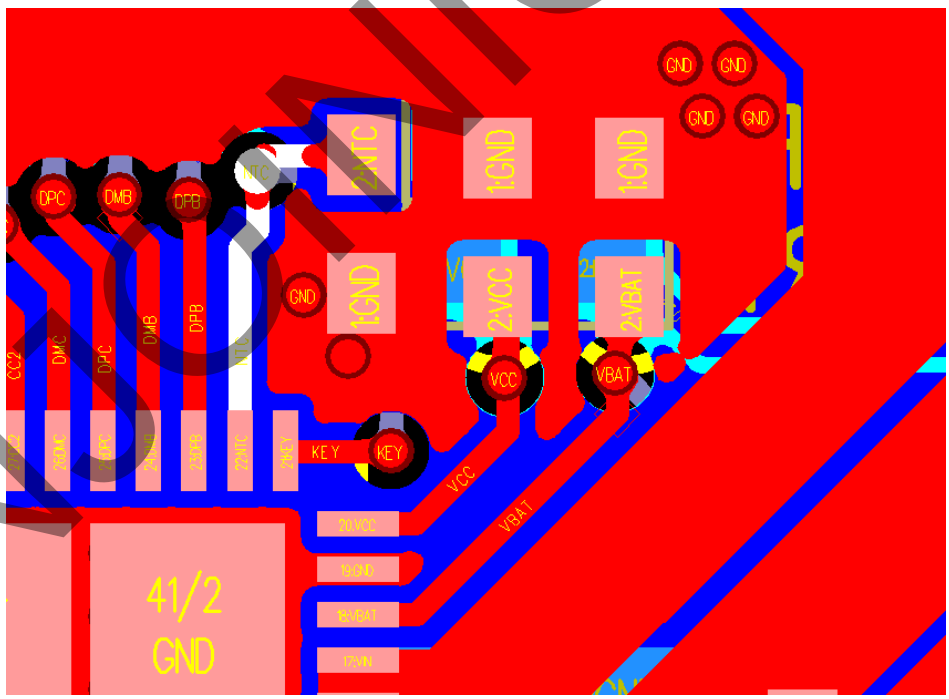


Figure24 Location of NTC capacitor

12.5. PIN and EPAD

There is an error in the chip manufacturing process, and there is a slight error in the package size parameters when the chip leaves the factory.In order to avoid the risk of short circuit between PIN and EPAD due to errors in PCB making process, select the min value of specification parameter from the PIN size(0.35mm) and EPAD size (4.10 mm) of IC package layout.

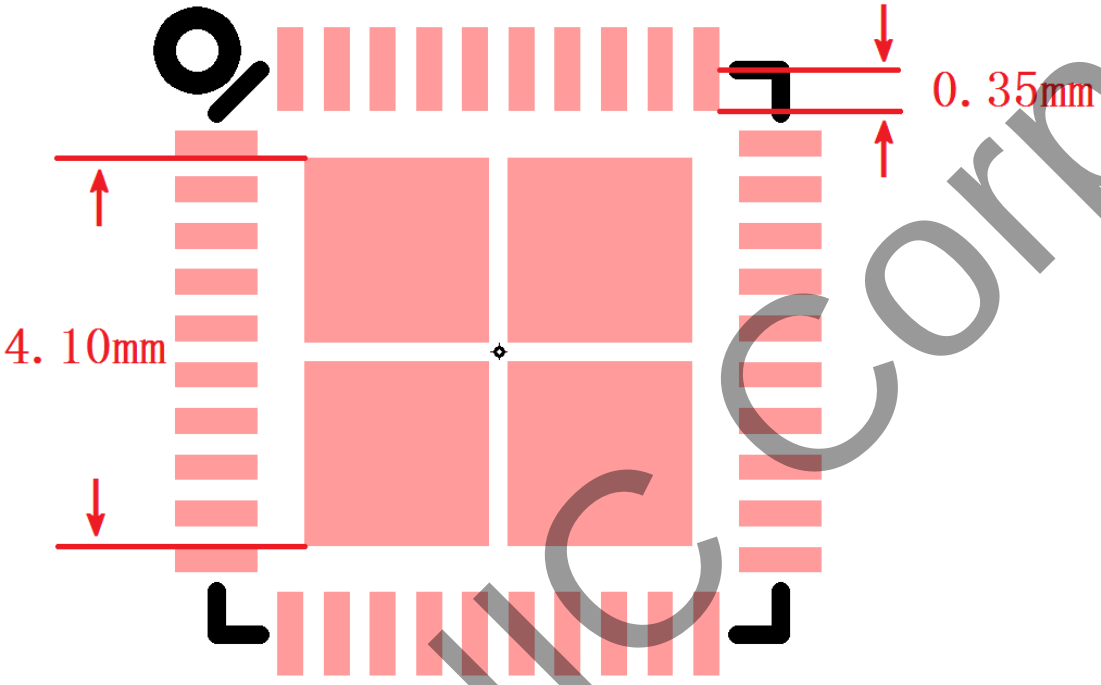
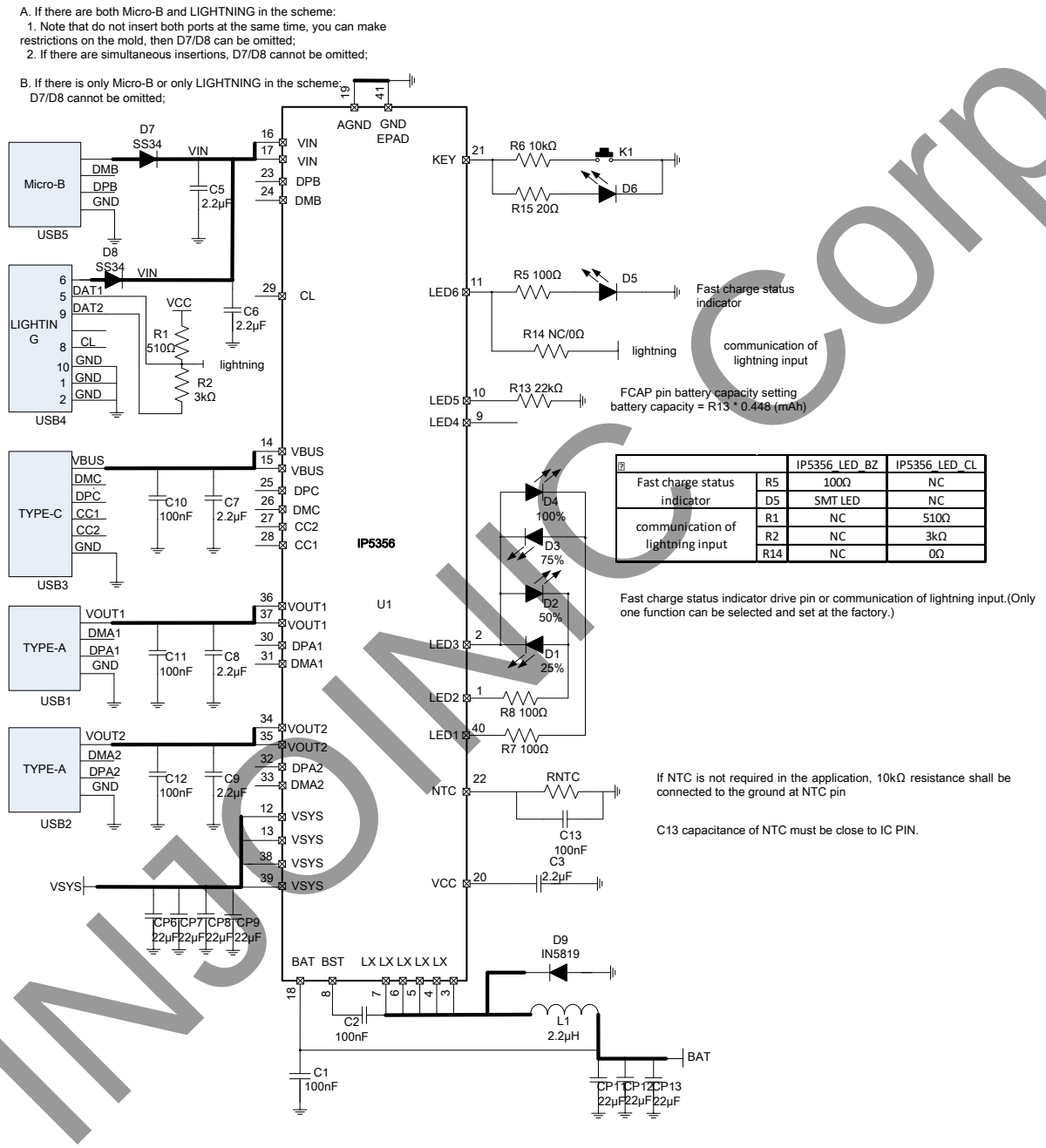


Figure25 PIN and EPAD

13. Typical Application Diagram

Total solution of fast charge power bank is merely realized by passive devices of MOSFET, inductor, capacitor and resistor.

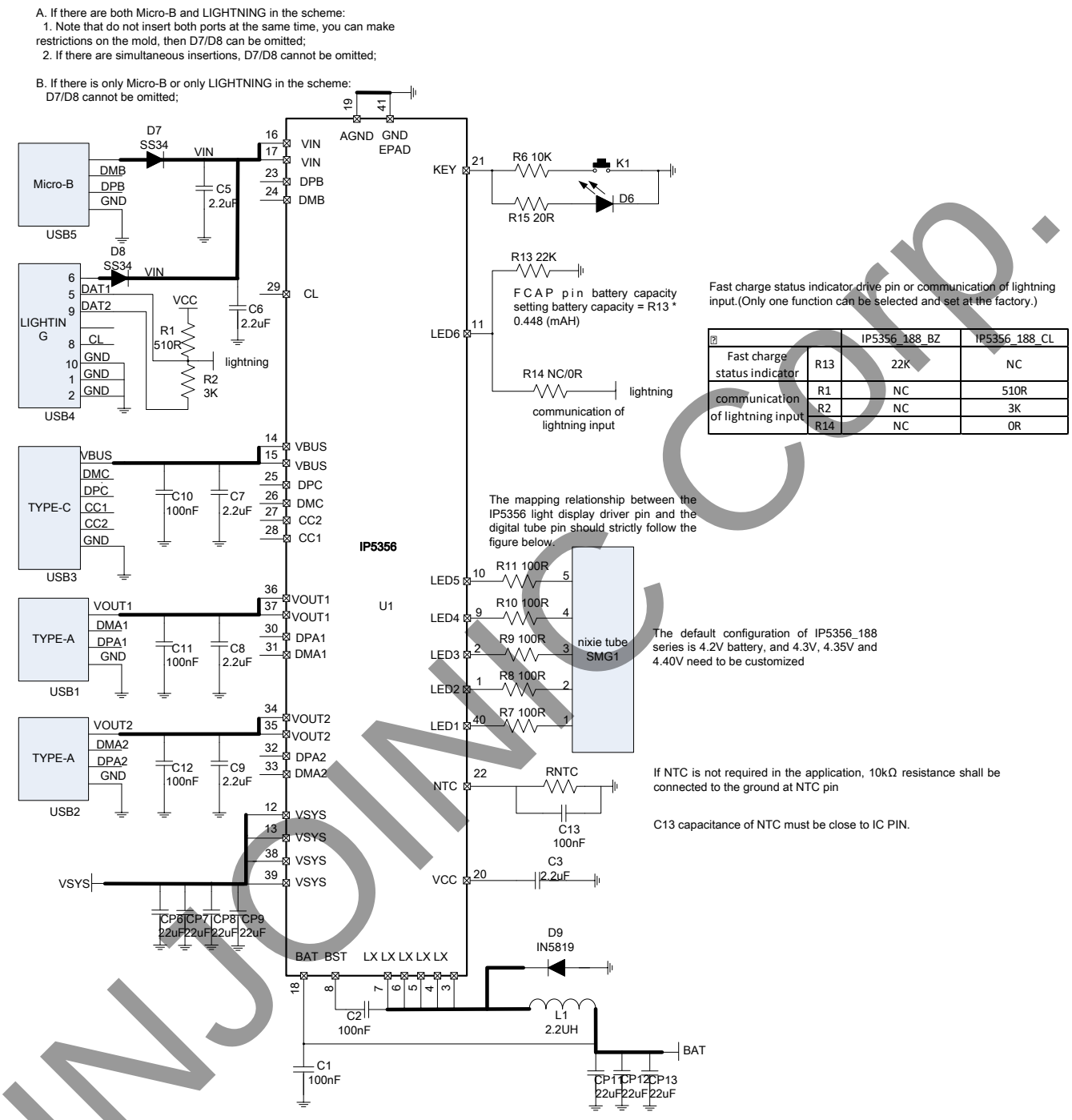
13.1. IP5356_LED_BZ / IP5356_LED_CL application



		IP5356_LED_BZ	IP5356_LED_CL
Fast charge status indicator	R5	100Ω	NC
	D5	SMT LED	NC
communication of lightning input	R1	NC	510Ω
	R2	NC	3kΩ
	R14	NC	0Ω

Figure 26 IP5356 LED application circuit

13.2. IP5356_188_BZ / IP5356_188_CL application



		IP5356_188_BZ	IP5356_188_CL
Fast charge status indicator	R13	22K	NC
communication of lightning input	R1	NC	510R
	R2	NC	3K
	R14	NC	0R

Figure 27 IP5356 Nixie tube application circuit

BOM list

No.	Part Name	Type	Location	Num	Note
1	SMT IC	QFN40 IP5356	U1	1	
2	SMT capacitor	0603 100nF 10% 16V	C1	1	
3	SMT capacitor	0603 100nF 10% 25V	C2	1	
4	SMT capacitor	0603 2.2μF 10% 16V	C3	1	
5	SMT capacitor	0603 2.2μF 10% 25V	C5 C6 C7 C8 C9	5	
6	SMT capacitor	0805 22μF 10% 16V	CP11 CP12 CP13	3	
7	SMT capacitor	0805 22μF 10% 25V	CP6 CP7 CP8 CP9	4	
8	SMT resistor	0603R 100Ω 1%	R7 R8	2	choosable, LED application circuit
9	SMT LED	0603 BLUE	D1 D2 D3 D4	4	
10	SMT resistor	0603R 100Ω 1%	R7 R8 R9 R10 R11	5	Choosable, Nixie tube application circuit
11	Nixie tube	YF2252SR-5	SMG1	1	
12	SMT resistor	0603R 100Ω 1%	R5	1	Choosable, fast charging lamp scheme
13	SMT LED	0603 RED	D5	1	
14	SMT resistor	0603R 22kΩ 1%	R13	1	Choosable, FCAP circuit
15	SMT Schottky	SS34	D7 D8	2	
16	SMT Schottky	IN5819	D9	1	
17	SMT resistor	0603R 510Ω 1%	R1	1	Communication circuit of apple lightning input BOM
18	SMT resistor	0603R 3kΩ 1%	R2	1	
19	SMT resistor	0603R NC / 0Ω 1%	R14	1	
20	SMT resistor	0603R 10kΩ 1%	R6	1	
21	SMT resistor	0603R 20Ω 1%	R15	1	
22	NTC THERMAL RESISTOR	10kΩ @25℃ B=3380	RNTC	1	NTC circuit BOM
23	SMT capacitor	0603 100nF 10% 16V	C13	1	
24	LED	5MM LED	D6	1	
25	inductor	2.2μH 10*10	L1	1	
26	KEY	SMT 3*6	K1	1	
27	OUTPUT USB	AF10 8 USB	USB1 USB2	2	
28	INPUT USB	MICRO-7-DIP-5.9	USB5	1	
29	USB C CONNECTOR	USB C CONNECTOR	USB3	1	
30	LIGHTNING CONNECTOR	apple lightning connector	USB4	1	

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	

13.3. IP5356_LED_CC LED application

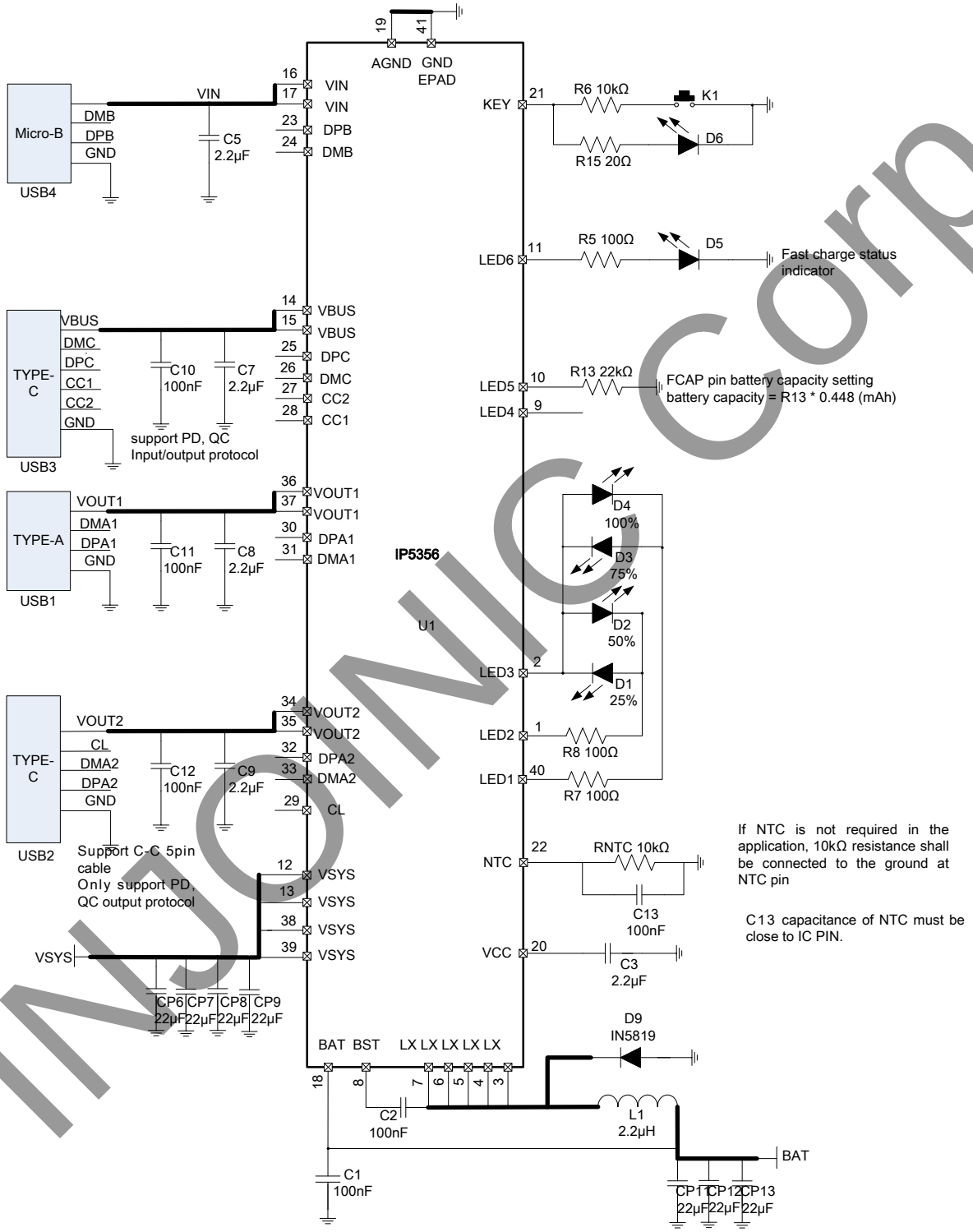


Figure 28 IP5356_LED_CC LED application circuit

13.4. IP5356_188_CC Nixie tube application

This scheme supports MICRO-B fast charging input, TYPE-C fast charging input and output, TYPE-C fast charging output and USB-A fast charging output.

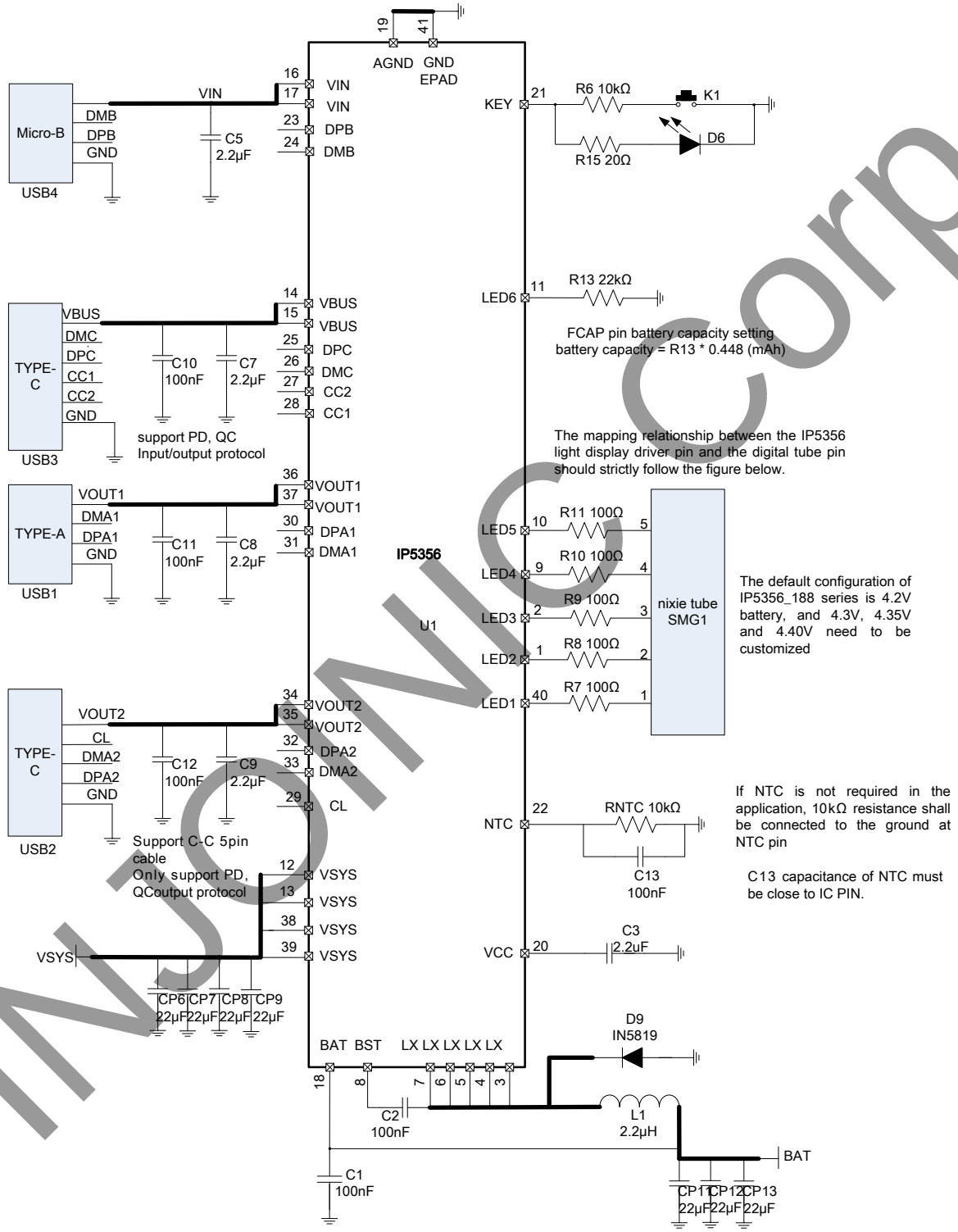


Figure 29 IP5356_188_CC Nixie tube application circuit

BOM list

No.	Part Name	Type	Location	Num	Note
1	SMT IC	QFN40 IP5356	U1	1	
2	SMT capacitor	0603 100nF 10% 16V	C1	1	
3	SMT capacitor	0603 100nF 10% 25V	C2	1	
4	SMT capacitor	0603 2.2μF 10% 16V	C3	1	
5	SMT capacitor	0603 2.2μF 10% 25V	C5 C6 C7 C8 C9	5	
6	SMT capacitor	0805 22μF 10% 16V	CP11 CP12 CP13	3	
7	SMT capacitor	0805 22μF 10% 25V	CP6 CP7 CP8 CP9	4	
8	SMT resistor	0603R 100Ω 1%	R7 R8	2	choosable, LED application circuit
9	SMT LED	0603 BLUE	D1 D2 D3 D4	4	
10	SMT resistor	0603R 100Ω 1%	R7 R8 R9 R10 R11	5	Choosable, Nixie tube application circuit
11	Nixie tube	YF2252SR-5	SMG1	1	
12	SMT resistor	0603R 100Ω 1%	R5	1	Choosable, fast charging lamp scheme
13	SMT LED	0603 RED	D5	1	
14	SMT resistor	0603R 22kΩ 1%	R13	1	Choosable, FCAP circuit
15	SMT Schottky	IN5819	D9	1	
16	SMT resistor	0603R 10Ω 1%	R6	1	
17	SMT resistor	0603R 20kΩ 1%	R15	1	
18	NTC THERMAL RESISTOR	10kΩ @25℃ B=4200	RNTC	1	NTC circuit BOM
19	SMT capacitor	0603 100nF 10% 16V	C13	1	
20	LED	5MM LED	D6	1	
21	inductor	2.2μH 10*10	L1	1	
22	KEY	SMT 3*6	K1	1	
23	OUTPUT USB	AF10 8 USB	USB1	1	
24	INPUT USB	USB C cable	USB2	1	
25	USB C CONNECTOR	USB C CONNECTOR	USB3	1	
26	LIGHTNING CONNECTOR	MICRO-7-DIP-5.9	USB4	1	

Recommended inductance model

DARFON PIN	Thickness (mm)	Inductance (μH)	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	

14. IC Silk Screen Description

Note:
1、 ——Injoinic Logo
2、IP5356——Part Number
3、LLLLLL——Manufacture lot number
4、 NN ——Internal tracking number
5、 ——Pin1 location

Figure 30 IP5356 Silk Screen Description

15. Package

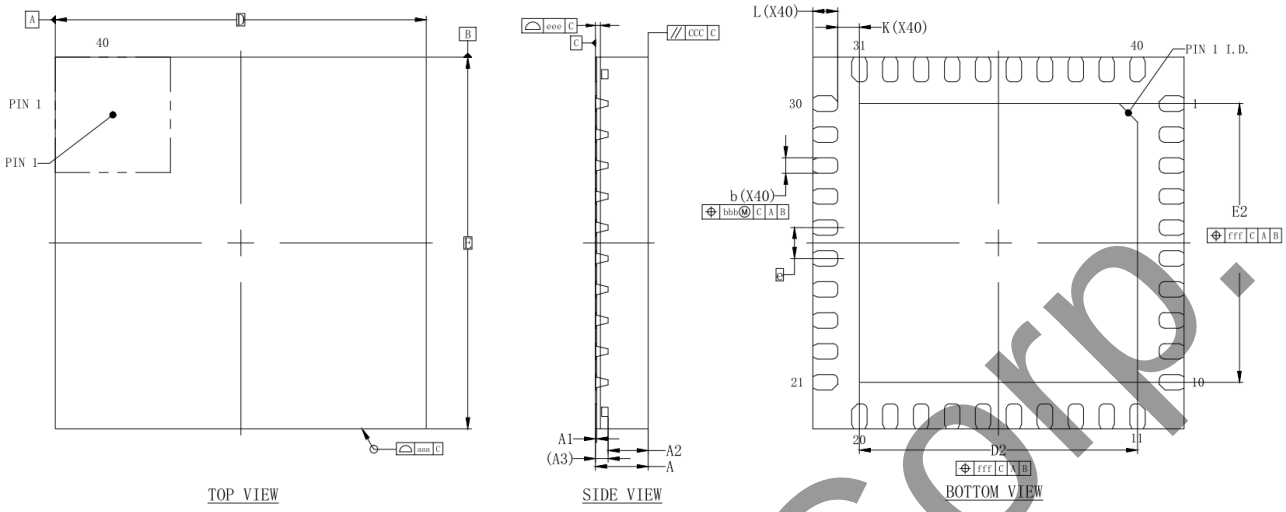


Figure 31 IP5356 Package size

Chart 18 Packaging information size table

Item		Symbol	Minimum	Normal	Maximum
Body Size	X	D		6.0 BSC	
	Y	E		6.0 BSC	
Exposed Pad Size	X	D2	4.40	4.50	4.60
	Y	E2	4.40	4.50	4.60
Total Thickness		A	0.80	0.85	0.90
Stand Off		A1	0	0.02	0.05
Molding Thickness		A2		0.65	
LF Thickness		A3		0.203 REF	
Lead Width		b	0.20	0.25	0.30
Lead Length		L	0.30	0.40	0.50
Lead Pitch		e		0.5 BSC	
Lead tip to Exposed Pad		K		0.35 REF	
Package Edge Tolerance		aaa		0.10	
Lead Offset		bbb		0.10	
Molding Flatness		ccc		0.10	
Coplanarity		eee		0.08	
Exposed Pad Offset		fff		0.10	

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