A Power Bank SOC With Integrated Buck-Boost Driver Supporting Bi-directional Fast Charging Protocol Such As SCP, PD3.0，UFCS, Supporting 2~4 Series Batteries and Supporting Maximum Power 65W

1 Feature

- **Supporting Multiple USB Ports Simultaneously**
- ✧ 2 USB-A output ports
- ✧ 1 USB-C input/output port
- ✧ 1 USB-B port or Lightning port input
- **Fast Charging**
- ✧ Every port supports fast charging
- ✧ Support QC2.0/QC3.0 output
- ✧ Support FCP input/output
- ✧ Support AFC input/output
- ✧ Support SCP output
- ✧ Support DRP try.SRC, PD3.0 input/output
- ✧ Support UFCS
- ✧ Support BC1.2,Apple
- **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/15V/20V input
- ✧ Support 5V/9V/12V/15V/20V output
- ✧ Support adjustable voltage in 20mV/step in PPS Mode
- ✧ Integrate hardware Bi-phase mark codec (BMC) protocol
- ✧ Integrated identification and support for E-MARK cables
- ✧ Integrate Physical Layer protocol
- ✧ Integrate hardware CRC
- ✧ Support Hard Reset
- **Power Control**
- ✧ Integrated bi-directional Buck-Boost NMOS driver
- ✧ Integrated Charge-Pump to control external NMOS
- **Charge**
- ✧ Adaptive charging current adjustment
- ✧ Support 4.15V/4.20V/4.30V/4.35V/4.40V battery
- ✧ Support charging Lithium Iron Phosphate Battery（3.65V）
- ✧ Support 2/3/4 batteries in series
- **Boost**
- ✧ Maximum output power 65W
- ✧ Up to 94%@5V/2A efficiency with synchronous switching
- ✧ Support line compensation
- **Battery Level Display**
- ✧ Integrated 14-bit ADC and coulombmeter
- ✧ Support 4/2/1 LEDs to indicate battery level
- ✧ Support 188 nixie tube
- ✧ Self-learning coulombmeter, more uniform power display
- ✧ Support configuring initial battery capacity by external pin
- **Other Functions**
- ✧ Automatic detection of mobile phone plugging and unplugging
- ✧ Fast charging status indication
- ✧ Battery temperature detection
- ✧ Enter standby mode automatically in light load
- ✧ Integrated lighting driver
- **Multiple Protections,High Reliability**
- ✧ Input overvoltage and undervoltage protection
- ✧ Output overcurrent, overvoltage, short circuit protection
- ✧ Battery overcharge, overdischarge, overcurrent protection
- ✧ Overtemperature protection
- ✧ NTC protection for charging and discharging battery
- ✧ ESD 4kV, input (including CC/DP/DM PINS) withstand voltage 30V
- **Low BOM Cost**
- ✧ Integrated switch power MOSFET driver
- ✧ Single inductor for charging and discharging
- **Package Size：6mm × 6mm 0.4Pitch QFN48**

2 Application Product

- Power bank, Portable Energy Storage Power Supply
- Portable devices such as mobile phones and tablets
- Electric tool

3 Description

IP5385 is a power management SOC that integrates QC2.0/QC3.0/SCP/UFCS output fast charging protocol, AFC/FCP input and output fast charging protocol, TYPE-C PD2.0/PD3.0 input and output fast charging protocol and PPS output protocol, BC1.2/iPhone protocol, synchronous bi-directional buck-boost converter, lithium battery charging management and battery power indicator, providing a complete power solution for fast charging mobile power supplies. It can support two USB-A ports, one USB-C port and one lightning port at the same time and fast charging when any port is connected alone. When two or more output ports are used at the same time, every port's output voltage is 5V.

Due to the high integration of IP5385, only one inductor is needed to realize the bidirectional buck-boost function. Only a few peripheral components are needed in the application, which effectively reduces the size of the overall solution and reduces the BOM cost.

IP5385 supports 2/3/4 series batteries and the synchronous switch buck-boost system can provide a maximum output capacity of 65W. When there is no load, it automatically enters the dormant state.

IP5385 synchronous switch charging system provides up to 8.0A charging current. The built-in IC temperature, battery temperature and input voltage control loop intelligently adjust the charging current.

IP5385 built-in 14-bit ADC can accurately measure battery voltage and current. Built-in power calculation method can accurately obtain battery power information. The battery power curve can be customized to accurately display the battery power.

IP5385 supports 4/2/1 LED power display, supports 188 and other nixie tube power display; supports battery temperature detection.

Directory

4 Reversion History

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

First version released V1.00 (Apr 2023)	Page
● First version released	1
Update version V1.00 to V1.10(Aug 2023)	
● Modify the description of pin 6 in the datasheet, that is, change the GPIO9 function to CC4 function First version released	6/8/10/33/34
● Modify capacity PIN selection relationship	23/33/34
● 2 lights, 1 light LED light models need to be customized	25

5 Typical Application

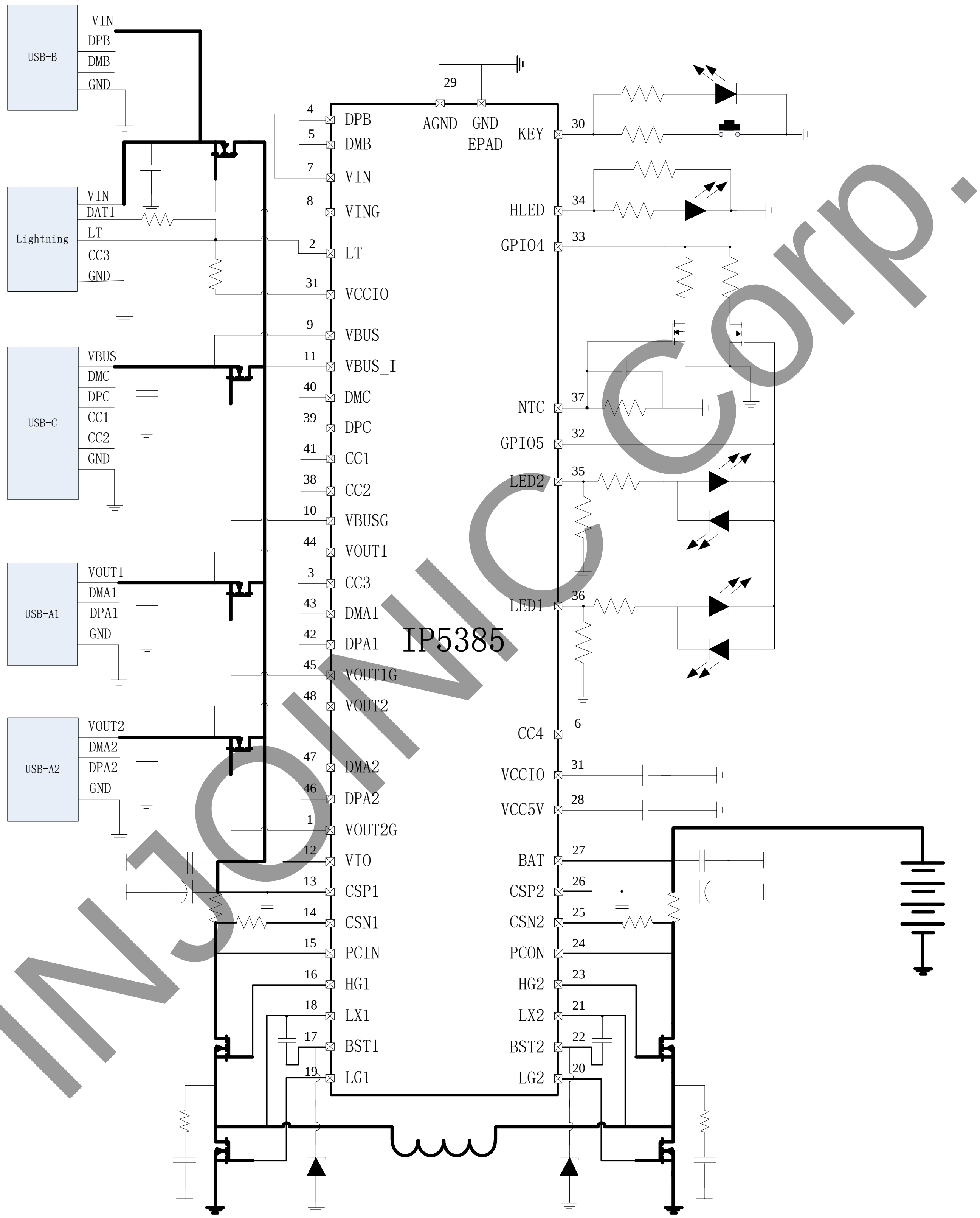


Figure 1 Simplified Application Schematic

6 IP Series Products List

6.1 Power Bank IC

IC Part No.	boost/charge power		Main features								Package	
	boost	charge	LED number	I2C	DCP	USB C	QC Certificate	PD3.0 /PPS	SuperCharge	UFCS	Package	Compa-tibility
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	
IP5406T	5V/2.4A	5V/2A	1,2,4	-	√	-	-	-	-	-	ESOP8	
IP5407	5V/2.4A	5V/2A	1,2,4	-	√	-	-	-	-	-	ESOP8	
IP5108U	5V/2A	5V/2A	3,4,5	√	-	-	-	-	-	-	ESOP16	
IP5109U	5V/2.1A	5V/2A	3,4,5	√	√	-	-	-	-	-	QFN24	PIN2PIN
IP5207U	5V/1.2A	5V/1A	3,4,5	√	√	-	-	-	-	-	QFN24	
IP5209U	5V/2.4A	5V/2A	3,4,5	√	√	-	-	-	-	-	QFN24	
IP5207T	5V/1.2A	5V/1A	1,2,3,4	√	√	-	-	-	-	-	QFN24	PIN2
IP5189T	5V/2.1A	5V/2A	1,2,3,4	√	√	-	-	-	-	-	QFN24	
IP5189TH	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	NixieTube	-	-	-	-	-	-	-	ESOP16	
IP5508	5V/2.4A	5V/2A	NixieTube	-	√	-	-	-	-	-	QFN32	
IP5320	5V/3.1A	5V/2.6A	NixieTube	√	√	√	-	-	-	-	QFN28	
IP5330	5V/3.1A	5V/2.6A	NixieTube	-	√	√	-	-	-	-	QFN32	
IP5566	5V/3.1A	5V/2.6A	1,2,3,4	-	√	√	-	-	-	-	QFN40	
IP5332	20W	18W	1,2,3,4	√	√	√	√	√	-	-	QFN32	
IP5328P	20W	18W	1,2,3,4	√	√	√	√	√	-	-	QFN40	
IP5353	22.5W	18W	4	√	√	√	√	√	√	-	QFN32	
IP5355	22.5W	18W	4	√	√	√	√	√	√	-	QFN32	
IP5356	22.5W	18W	NixieTube	√	√	√	√	√	√	-	QFN40	
IP5358	22.5W	18W	NixieTube	-	√	√	√	√	√	-	QFN48	
IP5568	22.5W	18W	NixieTube	-	√	√	√	√	√	-	QFN64	
IP5568U	22.5W	18W	NixieTube	-	√	√	√	√	√	-	QFN64	
IP5385	65W	65W	NixieTube	√	√	√	√	√	√	√	QFN48	
IP5386	45W	45W	NixieTube	√	√	√	√	√	√	-	QFN48	
IP5389	100W	100W	NixieTube	√	√	√	√	√	√	-	QFN64	

6.2 IP5385 Common Custom Product Description

Part No.	function description
IP5385_LAABC_BZ_Time Stamp	Support AABCL interface, support 2-4 batteries, maximum power 65W,support 4/2/1 LEDs
IP5385_S1AACL_BZ_Time Stamp	Support AACL interface, support 2-4 batteries, maximum power 65W,support S1 nixie tube
IP5385_S2AACL_BZ_Time Stamp	Support AACL interface, support 2-4 batteries, maximum power 65W,support S2 nixie tube

7 Pin Description

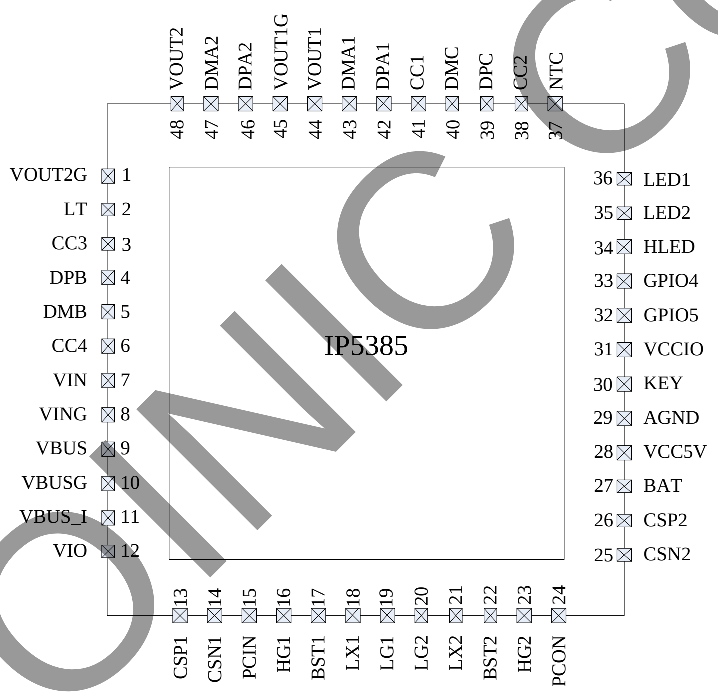


Figure 2 IP5385 Pin Diagram

7.1 IP5385 Pin Description

PIN Num	PIN Name	PIN description
1	VOUT2G	Used to control NMOS in USB-A2 port output path
2	LT	Lightning decoding pin
3	CC3	USB-C2/Lightning port detection and fast charging communication pin
4	DPB	Used for USB-B port fast charging intelligent recognition
5	DMB	Used for USB-B port fast charging intelligent recognition
6	CC4	USB-C2 port detection and fast charging communication pin

7	VIN	Input charging power pin of Lightning port
8	VING	Used to control input path NMOS of Lightning port
9	VBUS	VBUS input/output power supply pin of USB-C port
10	VBUSG	Used to control input/output path NMOS of USB-C port
11	VBUS_I	Used to detect current of USB-C port path
12	VIO	Mobile power input/output pin
13	CSP1	Current sampling positive terminal of mobile power input/output terminal
14	CSN1	Current sampling negative terminal of mobile power input/output terminal
15	PCIN	Mobile power input/output peak current sampling pin
16	HG1	Input/output terminal upper tube control pin of H-bridge power tube
17	BST1	Input/output terminal bootstrap voltage pin of H-bridge power tube
18	LX1	Inductor connection pin of mobile power input/output terminal
19	LG1	Input/output terminal lower tube control pin of H-bridge power tube
20	LG2	Battery terminal lower tube control pin of H-bridge power tube
21	LX2	Inductance connection pin of mobile power battery terminal
22	BST2	Battery terminal bootstrap voltage pin of H-bridge power tube
23	HG2	Battery terminal upper tube control pin of H-bridge power tube
24	PCON	Battery peak current sampling pin
25	CSN2	Current sampling negative terminal of battery terminal
26	CSP2	Current sampling positive terminal of battery terminal
27	BAT	Battery terminal pin
28	VCC5V	System 5V power supply, to supply power to the internal analog circuit of the IC
29	AGND	Analog ground
30	KEY	Key and light pin
31	VCCIO	System 3.3V power supply, to supply power to the internal digital circuit of the IC
32	GPIO5	Used to drive power indicator LED3
33	GPIO4	Used for battery number selection and Battery voltage selection
34	HLED	Fast charge mode indicator,reused as battery capacity selection.
35	LED2	Used to drive power indicator LED2, reused as PMAX selection.
36	LED1	Used to drive power indicator LED1, reused as NTC_MODE selection.
37	NTC	Used for NTC resistance detection.
38	CC2	Used for USB-C port detection and fast charging communication
39	DPC	Used for USB-C port fast charging intelligent recognition
40	DMC	Used for USB-C port fast charging intelligent recognition

41	CC1	Used for USB-C port detection and fast charging communication
42	DPA1	Used for USB-A1 port fast charging intelligent recognition
43	DMA1	Used for USB-A1 port fast charging intelligent recognition
44	VOUT1	USB-A1 port power output from this pin
45	VOUT1G	Used to control NMOS in USB-A1 port output path
46	DPA2	Used for USB-A2 port fast charging intelligent recognition
47	DMA2	Used for USB-A2 port fast charging intelligent recognition
48	VOUT2	USB-A2 port power output from this pin
49(EPAD)	GND	The system and heat dissipation ground must be in good contact with GND

8 Internal Block Diagram of the Chip

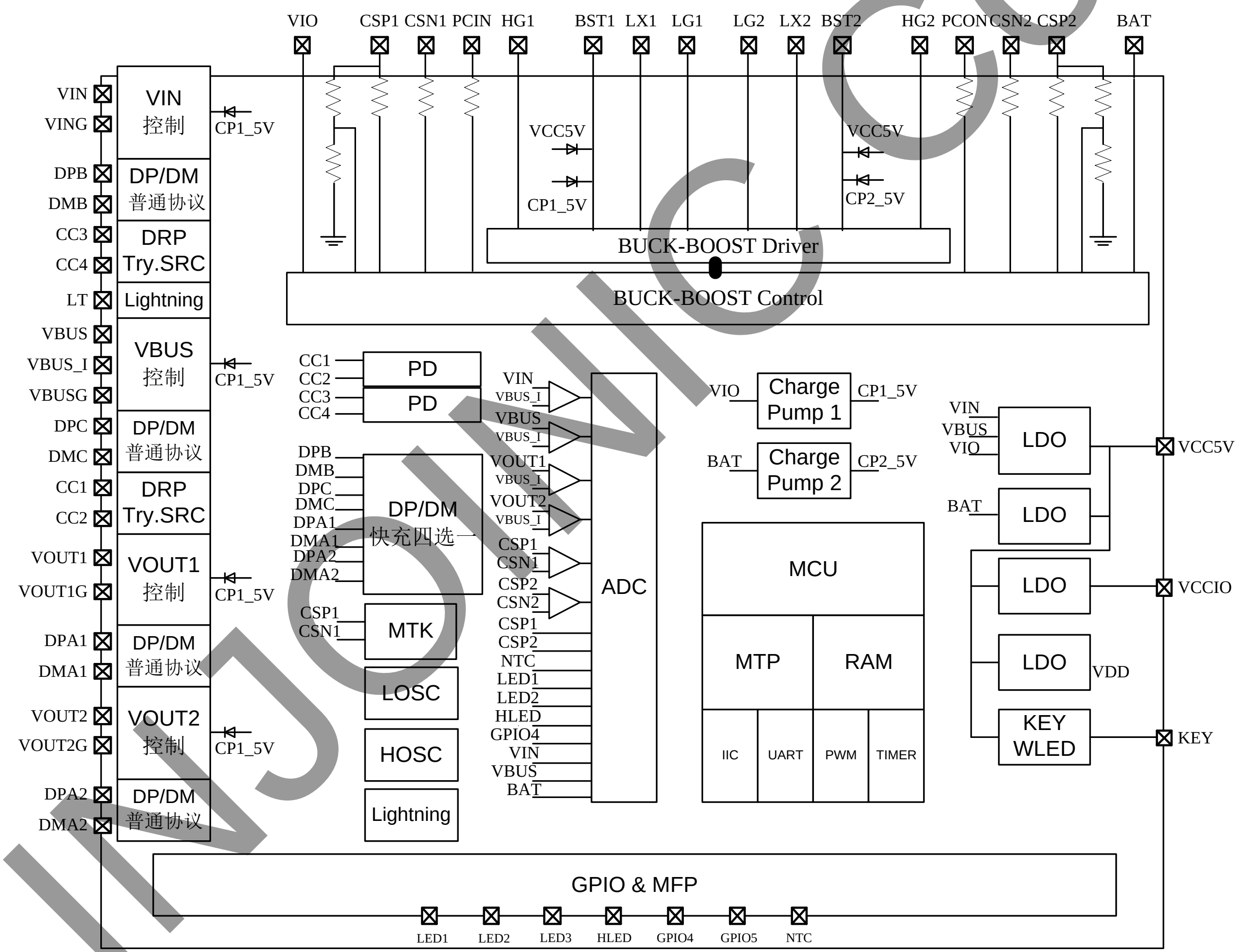


Figure 3 Internal Block Diagram Of The Chip

9 Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Input Voltage Range	VBAT/VIN/VBUS	-0.3 ~ 30	V
Protocol Port Voltage Range	DP/DM/CC	-0.3 ~ 30	V

Digital GPIO voltage range	LED/FCAP	-0.3 ~ 8	V
Junction Temperature Range	T_J	-40 ~ 125	℃
Storage Temperature Range	Tstg	-60 ~ 150	℃
Thermal Resistance (Junction to Ambient)	$θ_{JA}$	26	℃/W
Human Body Model (HBM)	ESD	4	kV

*Stresses higher than the values listed in the Absolute Maximum Ratings section may cause permanent damage to the device. Excessive exposure under any absolute maximum rating conditions may affect the reliability and service life of the device.

10 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Battery Voltage	VBAT	5.6		18	V
Input Voltage	VIN/VBUS	4.5		24	V
Working temperature	T_A	-40		85	℃

* Beyond these operating conditions, device operating characteristics cannot be guaranteed.

11 Electrical Characteristics

Unless otherwise specified, TA=25℃, L=4.7μH

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Charging System						
Input voltage	V_{IN}/V_{BUS}		4.5	5/9/12/15/20	25	V
Input overvoltage	V_{IN}			13	14	V
	V_{BUS}			22	24	V
Charging constant voltage	V_{TRGT}	The number of battery is N, R_{VSET} = 27kΩ	N*4.16	N*4.20	N*4.24	V
		The number of battery is N, R_{VSET} = 18kΩ	N*4.26	N*4.30	N*4.34	V
		The number of battery is N, R_{VSET} = 13kΩ	N*4.31	N*4.35	N*4.39	V
		The number of battery is N, R_{VSET} = 9.1kΩ	N*4.36	N*4.40	N*4.44	V
		The number of battery is N, R_{VSET} = 6.2kΩ	N*4.11	N*4.15	N*4.19	V
		The number of battery is N, R_{VSET} = 3.6kΩ	N*3.6	N*3.65	N*3.7	V
Charging Current	I_{CHRG}	VIN=5V, input current	1.8	2.0	2.3	A
		VIN=9V, input current	1.8	2.0	2.2	A
		VIN=12V, input current	1.35	1.5	1.7	A

		VBUS=5V, input current		2.7	3.0	3.3	A
		VBUS=9V，PD，input current	PMAX=20W	2	2.22	2.44	A
			PMAX>=30W	2.7	3.0	3.3	A
		VBUS=9V，Not PD，input current	PMAX>=20W	1.8	2.0	2.2	A
		VBUS=12V，PD，input current	PMAX=20W	1.5	1.67	1.85	A
			PMAX>=30W	2.2	2.5	2.8	
			PMAX>=45W	2.7	3.0	3.3	
		VBUS=12V，Not PD，input current	PMAX>=20W	1.3	1.5	1.7	A
		VBUS = 15V，PD or Not PD，input current	PMAX=30W	1.8	2.0	2.2	A
			PMAX=35W	2.1	2.33	2.55	
			PMAX>=45W	2.7	3.0	3.3	
		VBUS = 20V，PD or Not PD，input current	PMAX=30W	1.3	1.5	1.7	A
			PMAX=35W	1.55	1.75	1.95	
			PMAX=45W	2.0	2.25	2.5	
			PMAX=60W	2.7	3.0	3.3	
		VBUS = 20V，PD，input current	PMAX=65W	2.7	3.0	3.3	
Trickle Charging Current	I_{TRKL}	VIN=5V, VBAT<2.5V			40	100	mA
		VIN=5V, 2.5V<=VBAT<N*3.0V		150	0.025*FCAP	1000	mA
Trickle cut-off voltage	V_{TRKL}	The number of battery is N, V_{TRGT} is not 3.65V.		N*2.9	N*3.0	N*3.1	V
	V_{TRKL}	The number of battery is N, V_{TRGT} is 3.65V.		N*2.7	N*2.75	N*2.85	V
Charging stop current	I_{STOP}			100	0.025*FCAP		mA
Recharging Voltage Threshold	V_{RCH}	The number of battery is N.			V_{TRGT} – N*0.1		V
Charging cut-off time	T_{END}			45	48	51	Hour
Boost System							
Battery operation voltage	V_{BAT}	The number of battery is N.		N*2.75		N*4.5	V

DC output voltage	QC2.0 V_{OUT}	V_{OUT}=5V@1A	4.75	5.00	5.25	V
		V_{OUT}=9V@1A	8.70	9.00	9.30	V
		V_{OUT}=12V@1A	11.60	12.00	12.40	V
	QC3.0 V_{OUT}	@1A	3.6		12	V
	QC3.0 Step			200		mV
	PPS Step			20		mV
Output voltage ripple	ΔV_{OUT}	VBAT=4*3.7V, VOUT=5.0V, fs=400kHz, Iout=1A		100		mV
		VBAT=4*3.7V, VOUT=9.0V，fs=400kHz, Iout=1A		100		mV
		VBAT=4*3.7V，VOUT=12V，fs=400kHz, Iout=1A		100		mV
		VBAT=4*3.7V，VOUT=15V，fs=400kHz, Iout=1A		100		mV
		VBAT=4*3.7V，VOUT=20V，fs=400kHz, Iout=1A		100		mV
Maximum output power of discharge system	Pmax	Under the PD protocol, different PMAX resistance values correspond to different Pmax.	30		45	W
Boost efficiency	η_{out}	V_{BAT}=15V, V_{OUT}=5V, I_{OUT}=3A		89.5		%
		V_{BAT}=15V, V_{OUT}=9V, I_{OUT}=3A		93.5		%
		V_{BAT}=15V, V_{OUT}=12V, I_{OUT}=3A		93		%
		V_{BAT}=15V, V_{OUT}=15V, I_{OUT}=3A		94		%
		V_{BAT}=15V, V_{OUT}=20V, I_{OUT}=3.25A		95.3		%
Boost system shutdown current	I_{shut}	VBAT=N*3.7V,multiple ports output 5V	4.3	4.6	5.0	A
		VBAT= N *3.7V,single port outputs 5V	3.2	3.6	4.0	A
		VBAT= N *3.7V, single port outputs 9V， not under PD protocol condition	2.22	2.4	2.7	A
		VBAT= N *3.7V, single port outputs 12V， not under PD protocol condition	1.67	1.8	2	A

		VBAT= N *3.7V, single port outputs， under PD protocol condition		PDO * 1.15		A
Output line compensation voltage	V_{COMP}	VIO<=9V		70		mV/A
Shutdown power threshold under light load condition	P_{out}	VBAT= N*3.7V		350		mW
Detection time for overcurrent load	T_{UVD}	The output voltage is continuously lower than 2.4V.		30		ms
Detection time for short-circuit load	T_{OCD}	The output voltage is continuously lower than 2.2V.		40		μs
Control System						
Switch frequency	Fs	Discharging switch frequency		400		kHz
		Charging switch frequency		400		kHz
VCCIO output voltage	V_{CCIO}		3.15	3.30	3.45	V
Standby current at the battery terminal	I_{STB}	VBAT=14.8V. The average current after the key is turned off.		180	400	μA
LDO output current	I_{LDO}		25	30	35	mA
The current that drives LED lighting	I_{WLED}		10	15	20	mA
The current that drives LED display	I_{L1} I_{L2} I_{L3}	Voltage decreases 10%.		3	9	mA
Detection time for automatic shutdown when total load is light	$T1_{load}$	The load power is continuously less than 350mW.	30	32	34	s
Detection time for automatic shutdown of output port under light load	$T2_{load}$		14	16	18	s
Detection time of short press on	$T_{OnDebounce}$		60		500	ms

key for waking						
The time of opening WLED	$T_{Keylight}$		1.2	2	3	s
Temperature which leads to power off	T_{OTP}	heating	110	125	140	℃
Temperature hysteresis after power off	ΔT_{OTP}			40		℃

12 Description of Function

12.1 Lock State and Activation

When the IP5385 is connected to the battery for the first time, no matter what the battery voltage is, the chip is in a lock state, and the lowest digit of the battery indicator will flash 4 times, or the nixie tube 0% will flash 4 times to indicate. When not in the charging state, if the battery voltage is too low, the shutdown will be triggered, and IP5385 will go into lock state at this time.

In the low battery state, in order to reduce static power consumption, IP5385 can't detect the insertion of the load and it can't be activated by pressing the key. At this time, pressing the key can't activate the buck-boost output, but the lowest battery indicator will flash 4 times to prompt.

In the lock state, the chip can be activated only after entering the charging state.

12.2 Charging

IP5385 integrates the trickle current, constant current and constant voltage lithium battery charging management system with synchronous switch structure, and supports automatic matching of different charging voltage specifications:

When the battery voltage is less than V_{TRKL}, it will apply trickle charging;

When the battery voltage is greater than V_{TRKL}, it will apply constant current charging, and the maximum charging current of the battery terminal is 8.0A;

When the battery voltage is close to the setting value, it will apply constant voltage charging; when the battery terminal charging current is less than the stop charging current I_{STOP} and the battery voltage is close to the constant voltage, the charging is stopped. After the charging is completed, if the battery voltage is lower than (V_{TRGT}-N*0.1)V, it will restart the battery charging.

IP5385 has switch charging technology with a switching frequency of 400kHz. When charging with ordinary 5V input, the input power is 10W; when charging with fast charging input, the maximum input power is 65W. The charging efficiency can reach 96%, which can shorten the charging time by 3/4.

IP5385 supports simultaneous charging and discharging. When charging and discharging simultaneously, both input and output are 5V.

12.3 Boost

IP5385 integrates a synchronous switching converter system that supports high-voltage output and supports a wide voltage range of 3.0V~21V. The synchronous switching buck-boost system can provide a maximum output capacity of 65W. The built-in soft-start function prevents malfunctions caused by excessive inrush current during start-up.It also has output overcurrent, short circuit, overvoltage, overtemperature and other protective functions to ensure the stable and reliable operation of the system.

The current of the discharging system can be automatically adjusted with the temperature to ensure that the IC temperature is below the set temperature.

VBAT =15V，VOUT=5V/9V/12V/15V/20V，the boost efficiency curve is as follows：

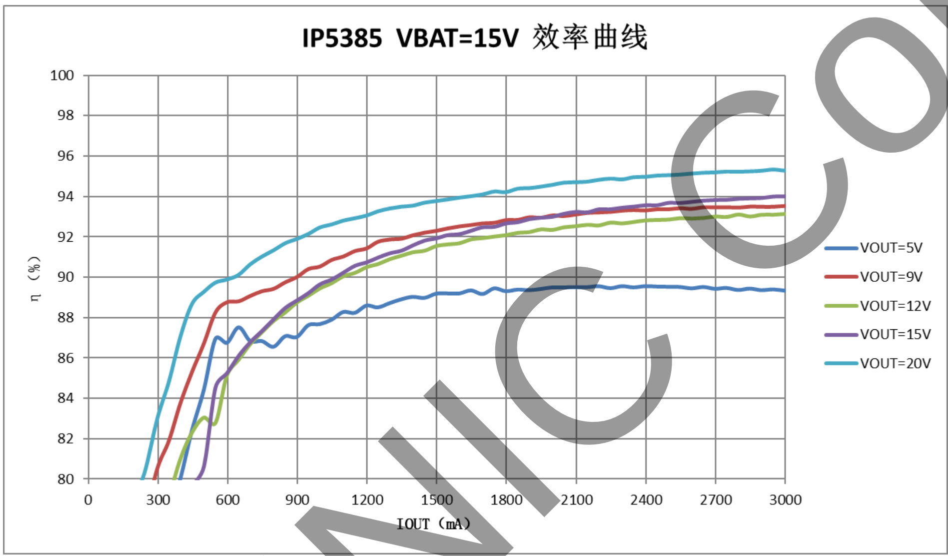


Figure 4 Boost Efficiency Curve Under The Condition Of VBAT=15V

12.3.1 USB C

IP5385 integrates USB C input and output recognition interfaces, automatically switches the built-in pull-up and pull-down resistors, and automatically recognizes charging and discharging properties of the inserted device. With Try.SRC function, when the attached device is also DRP device, IP5385 will supply power for the opposite device.

When it works as a DFP, it will output 3A current capability information through CC pin; when it works as a UFP, it can identify the output current capability of the opposite device.

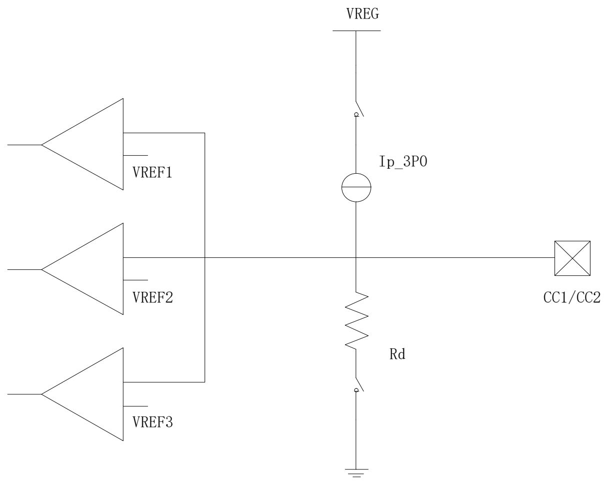


Figure 5 CC Internal Circuit

Name	Value
Ip_3P0	330μA
Rd	5.1k

Table 1 Pull-up And Pull-Down Ability

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

Table 2 Comparator Threshold Of Pull-Up Ip

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	

Table 3 Comparator Threshold Of Pull-Down Resistor Rd

Figure 4-36 DRP Timing

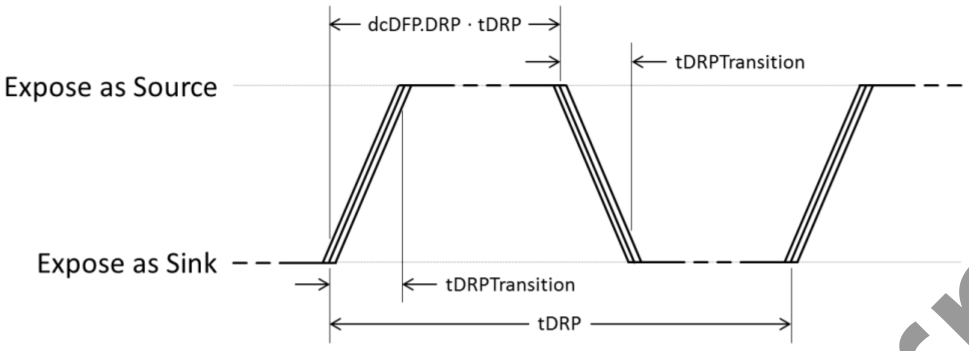


Figure 6 USB C Detection Cycle

	Minimum	Maximum	Description
tDRP	50 ms	100 ms	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	0 ms	1 ms	The time a DRP shall complete transitions between Source and Sink roles during role resolution
tDRPTry	75 ms	150 ms	Wait time associated with the Try.SRC state.
tDRPTryWait	400 ms	800 ms	Wait time associated with the Try.SNK state.
tTryTimeout	550 ms	1100 ms	Timeout for transition from Try.SRC to TryWait.SNK.
tVPDDetach	10 ms	20 ms	Time for a DRP to detect that the connected Charge-Through VCONN-Powered USB Device has been detached, after VBUS has been removed.

Table 4 USB-C Detection State Transition

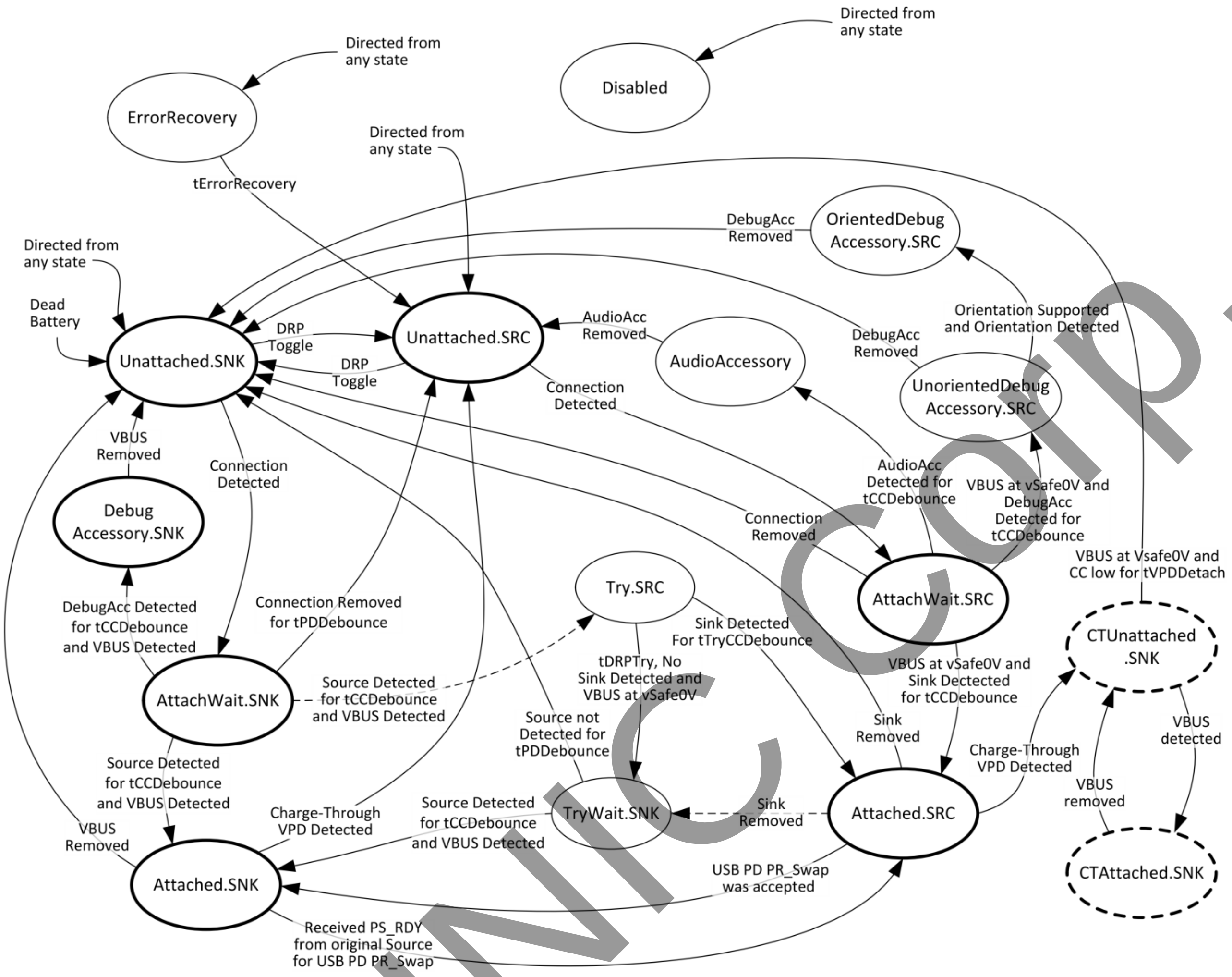


Figure 7 USB-C Detects State Transitions

12.3.2 USB C PD

IP5385 integrates USB C Power Delivery PD2.0/PD3.0/PPS (Programmable Power Supply) protocol,physical (PHY) layer for data transmitting/receiving across the CC wire and hardware biphase mark coding (BMC) module.

IP5385 supports PD2.0/PD3.0 bidirectional input/output protocol and PPS output protocol. The maximum output power is 65W.Input voltage gears includes 5V, 9V, 12V, 15V, 20V.Output voltage gears includes 5V, 9V, 12V, 15V, 20V.

When recognizing the E-MARK cable, the output broadcast capability is 5V/3A，9V/3A，12V/3A，15V/3A，20V/3.25A，PPS 3.3~21V/3A; When the E-MARK cable is not recognized, the output broadcast capability is 5V/3A，9V/3A，12V/3A，15V/3A，20V/3A，PPS 3.3~21V/3A.

12.3.3 Fast Charging Protocol

IP5385 supports multiple fast charging protocols: QC2.0、QC3.0、FCP、AFC、SCP、VOOC、Apple、UFCS.

When the mobile power bank charges the mobile phone, it will automatically detect the fast charging sequence on the DP and DM PINs after entering the discharge mode, and intelligently identify the type of mobile phone，which support QC2.0/QC3.0/QC3+, FCP, AFC, SCP protocol, Apple 2.4A mode, BC1.2 ordinary 1A mode.

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

For BC1.2 mode: DP short to DM.

In the BC1.2 mode, when the DP voltage is detected to be greater than 0.325V and less than 2V for 1.25s, the initial judgment is that there is a fast charging request. At this time, the short circuit between DP and DM will be disconnected, and DM will be pulled down to ground by a 20kΩ resistor. If it is satisfied that the DP voltage is greater than 0.325V and less than 2V, and the DM voltage is less than 0.325V for 2ms, the fast charging connection is considered successful. After that, the requested voltage can be output according to the requirements of QC2.0,QC3.0. As long as the DP voltage is less than 0.325V, the fast charge mode is forced to exit, and the output voltage immediately returns to the default 5V.

Table 5 QC2.0,QC3.0 Rules For Requesting Output Voltage

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	hold

Continuous Mode is the unique working mode of QC3.0. In this mode, the output voltage can be adjusted in a 200mV step according to the QC3.0 protocol requirements.

Table 6 The Fast Charging Protocol Supported By Each Port Of IP5385

Protocols	VOUT1 Output	VOUT2 Output	Lightning Input	TYPEC Output	TYPEC Input
QC2.0	√	√	-	√	-
QC3.0	√	√	-	√	-
QC3+	-	-	-	-	-
AFC	√	√	-	√	√
FCP	√	√	-	√	√
SCP	√	√	-	√	-
VOOC	√	√	-	-	-
PD2.0	-	-	√	√	√
PD3.0	-	-	√	√	√
PPS	-	-	-	√	-
UFCS	√	√	-	√	-

supported：√

not supported：-

12.4 Charging and Discharging Path Management

12.4.1 Standby:

If Lightning or USB-C is connected to a power supply, charging can be started directly.

If a USB-C UFP device is inserted into USB-C or an electrical device is inserted into USB-A, the discharging function can be automatically turned on.

IP5385 will turn on when the key is pressed or there is a load on USB-A1, USB-A2, or USB-C, otherwise it will keep standby state.

12.4.2 Discharging:

When the key is not pressed, only the path of the output port that is connected to electrical device will be opened, and the path of the output port that is not connected to electrical device will be closed.

Any port of USB-A1, USB-A2, USB-C can support output fast charging protocol, because of a single inductor solution, it can only support one voltage output. In other words, It only supports fast charging output when only one output port is turned on. When two or three output ports are used at the same time, the fast charging function will be automatically turned off.

According to the connection shown in the "Simplified application schematic", when any output port has entered fast charging output mode, if another output port is plugged in with an electrical device, it will first close all the output ports, turn off the high-voltage fast charge function, and then turn on the output port where the device exists. At this time, all the output ports only support Apple and BC1.2 charging. When in the multi-port output mode, if the output current of any output port is less than about 80mA (MOS Rds_ON@15mΩ), the port will be automatically closed after 16s. When it is detected that the number of electrical device is reduced from multiple to one, after about 16s, all output ports will be closed first, then the high-voltage fast charging function will be turned on, and the output port connected to the electrical device will be turned on. In this way, the device can be reactivated to request a fast charging. When only one output port is turned on, and total output power is less than about 350mW for about 32s, IP5385 will close the output port, stop discharging and enter standby state.

12.4.3 Charging:

Any one of Lightning and USB-C can be plugged into a power source to charge the battery. If they are all connected to the power source, the first plugged-in power source will be used first for charging.

In the case of charging only, it will automatically recognize the fast charging mode of the power supply and automatically match the appropriate charging voltage and charging current.

12.4.4 Charge while discharging

When the charging power supply and the electrical device are plugged in at the same time, the chip will automatically enter the charging and discharging mode. In this mode, it will automatically close the internal fast charging input request. In order to charge the electrical device normally, IP5385 will increase the charging undervoltage loop to above 4.9V to ensure that the electrical device is given priority to supply power.When the VIO voltage is only 5V, the discharging path is opened to supply power to the electrical device; if the VIO voltage is greater than 5.6V, for safety reasons, the discharging path will not be opened.

During the charging and discharging process, if the charging power is unplugged, IP5385 will turn off the charging and restart discharging to supply power to the electrical device. For safety reasons, and to reactivate the mobile phone to request fast charging, the voltage will drop to 0V for a period of time during the conversion process.

During the charging and discharging process, if the electrical device is unplugged, or the electrical device is fully charged and stops drawing power, the corresponding discharging path will be automatically closed after about 16s. When the discharging paths are closed and the state returns to the charging only mode, the charging undervoltage loop will be lowered and the fast charging will be automatically reactivated, then the charging of the mobile power supply will be accelerated.

12.5 Automatic Detection for Mobile Phone

12.5.1 Automatic detection for mobile phone insertion

If an inserted phone has been automactically detected by IP5385, IP5385 will wake up from standby state immediately and turn on the boost to charge the phone. This design can save the step of turning on the key and support the mold scheme without key.

12.5.2 Automatic detection for fully charged mobile phone

IP5385 samples the output current of each port through the on-chip ADC. When the output current of a single port is less than about 80mA (MOS Rds_ON@15mΩ) and lasts for about 16s, the output port will be closed. When the total output power is less than about 350mW and lasts for about 32s, it is considered that the mobile phones of all output ports are fully charged or unplugged, and the buck-boost output will be automatically turned off.

12.6 Key Function

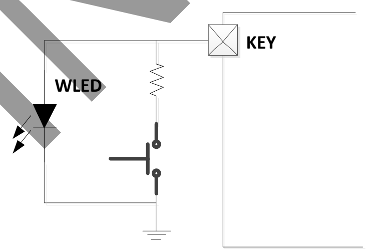


Figure 8 Key Circuit

Key circuit is illustrated in Figure 8, which can recognize short press or long press operation.

- Pressing the key for longer than 100ms but less than 2s is a short press action.Short press will turn on the battery indicator and boost output.
- Pressing the key for longer than 2s is a long press action. Press and hold to turn the light on or off.
- There will be no response when the key is pressed for less than 30ms.
- Short press the button for two consecutive times within 1s, the boost output, power display and lighting will be turned off.
- Long press for 10s to reset the entire system.

12.7 Fast Charging Status Indicator

HLED is used to indicate the current fast charging mode. Regardless of charging or discharging, the indicator will automatically light up when entering the fast charging mode and the output is not 5V.

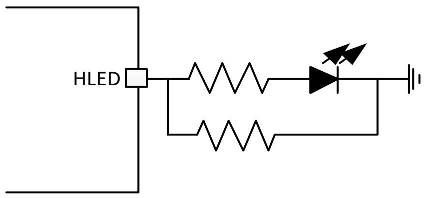


Figure 9 Fast Charging State Indication

12.8 Coulombmeter and Battery Level Display

IP5385 has a built-in coulombmeter, which can realize accurate battery power calculation.
IP5385 supports 4-LED,2-LED,1LED mode.
IP5385 supports 188 nixie tube to display power.

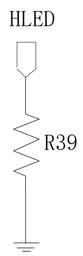
12.8.1 Coulombmeter

IP5385 supports externally setting the initial capacity of the battery, and uses the integral of the current and time of the battery terminal to manage the remaining capacity of the battery. When a 5 mΩ detection resistor is used between the battery current detection pins CSP2 and CSN2, the current battery capacity can be accurately displayed. IP5385 supports the automatic calibration of the total capacity of the current battery in a complete charging process from 0% to 100%, and more reasonable management of the actual capacity of the battery.

IP5385 sets the system battery capacity by determining the R39 resistance value of the HLED pin connection, with R39 defaulting to 2.5k Ω. For applications with 2 batteries, battery capacity=R39 * 2.0 (mAH), for applications with 3-4 batteries, battery capacity=R39 * 1.0 (mAH).

The minimum supported capacity is 2500mAH, and the maximum supported capacity is 20000mAH, which is the capacity of a single battery.

When the voltage on the HLED pin is less than 160mV or greater than 1000mV, the R39 resistor recognizes a short circuit or open circuit state, resulting in abnormal capacity initialization settings.



容量		R39
2 节电池	3~4节电池	
5000mAH	2500mAH	2. 5K
10000mAH	5000mAH	5K
15000mAH	7500mAH	7. 5K
20000mAH	10000mAH	10K

电池容量：
1、2节电池应用时：FCAP=R*2.0
2、3~4节电池应用时：FCAP=R*1.0
注：表中电芯容量指单节电池的电芯容量。
例如：3节5000mAH电池串联，容量设置为
5000mAH即可，R39选择5K。

Figure 10 Battery Capacity Configuration Circuit

12.8.2 LED Power Display Mode

IP5385 4-LED,2-LED,1-LED mode to display the capacity of the battery is as follows:

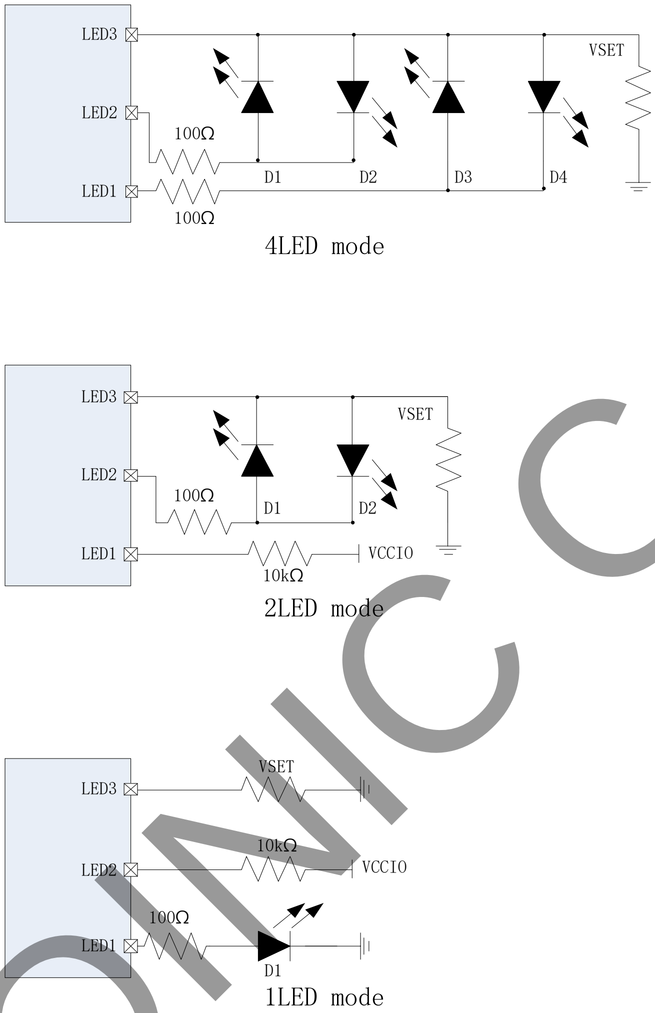


Figure 11 4/2/1-LED Connection

4-LED display mode:

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

Table 7 Charging Lamp Display

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

Table 8 Discharging Lamp Display

2-LED display mode:
charging: The D1 flashes in a 2s cycle (1s on and 1s off), and is always on when fully charged.
discharging: The D2 is always on, and when the power is lower than 5%, it flashes at 1Hz (0.5s on and 0.5s off).

1-LED display mode:
charging: The D1 flashes in a 2s cycle (1s on and 1s off), and is always on when fully charged.
discharging: The D1 is always on, and when the power is lower than 5%, it flashes at 1Hz (0.5s on and 0.5s off).

Note: The 2 lamp and 1 lamp modes need to be customized, and the schematic diagram of the corresponding model does not need to be changed. Simply refer to the above figure to change the peripheral circuits of the LED1, LED2, and LED3 pins.

12.8.3 188 Nixie Tube Display Mode

The nixie tube supported by IP5385 is as follows:

Table 9 Nixie Tube Display Mode

Nixie Tube	During charging		During discharging	
	Not fully charged	Fully charged	Battery capacity <5%	Battery capacity>5%
188	0-99% ones place 0.5Hz Flash	100% always on	0-5% ones place 1Hz Flash	5%-100% always on

S1 type 188 nixie tube is as follows:

(未注尺寸公差 Unspecified Tolerances is: ±0.2　发光颜色：白色、翠绿

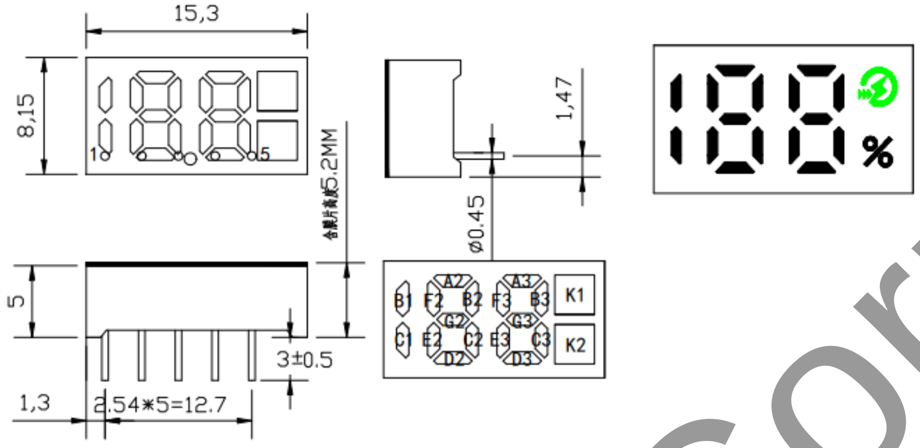


Figure 12　Nixie Tube

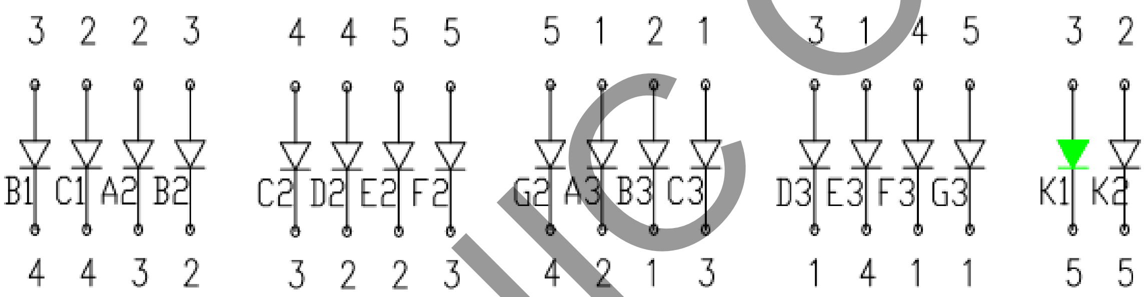
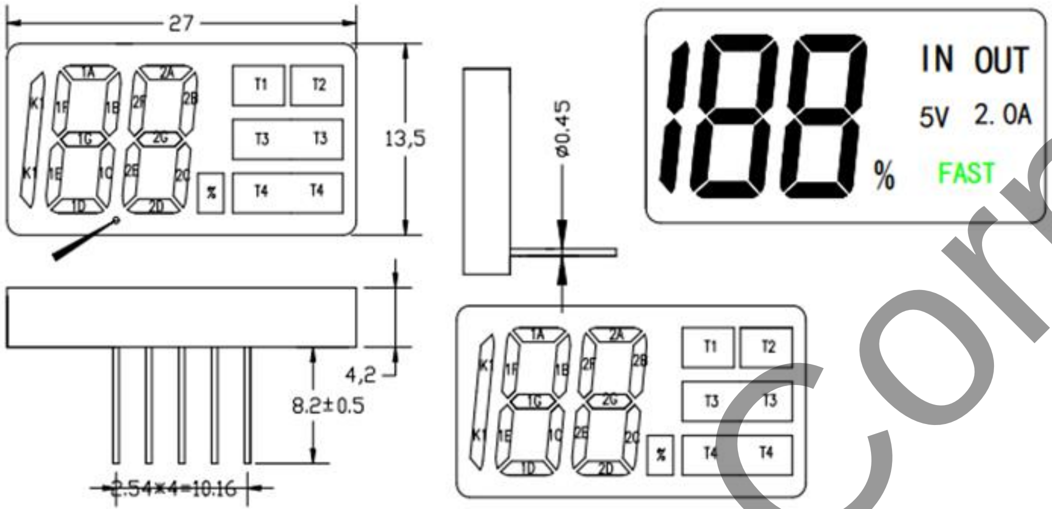


Figure 13　S1 type 188 Nixie Tube Circuit

S2 type 188 nixie tube is as follows:

3.结构尺寸（Mechanical Outline）：

(未注尺寸公差 Unspecified Tolerances is: ±0.2　　发光颜色：白色、翠绿



4. 电路图（Circuit Diagram）：

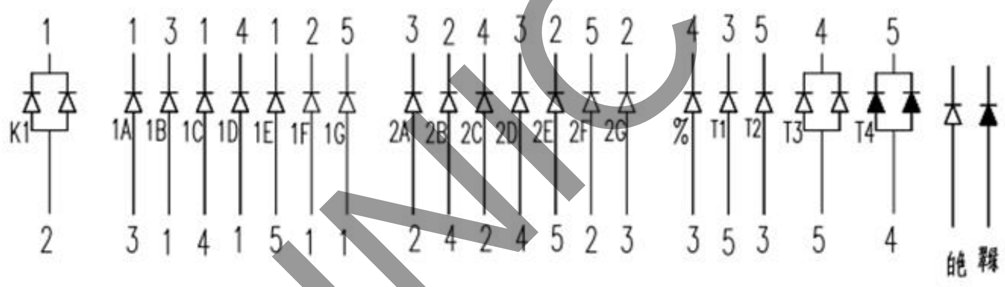
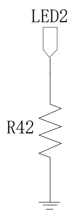


Figure 14　S2 type 188 Nixie Tube Circuit

12.9 Setting the System Input/Output Maximum Power

IP5385 sets the maximum input and output power of the system by judging the resistance value connected to the LED2 PIN.

Input and output maximum power configuration table:



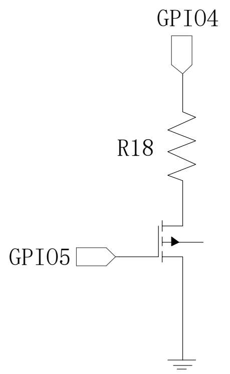
R42	最大输入功率	最大输出功率
27kΩ	65W	65W
18kΩ	60W	60W
13kΩ	45W	45W
9.1kΩ	35W	35W
6.2kΩ	30W	30W
3.6kΩ	20W	30W

Figure 15　Power Configuration And Connection Method

12.10 Setting the Number of Batteries in Series

IP5385 sets the number of system batteries in series by judging the resistance value of the R17 resistor connected to the HLED pin, and configures the corresponding battery parameters.

Configuration table of the number of batteries in series:



R17	电池串数
9.1kΩ	4串
6.2kΩ	3串
3.6kΩ	2串

Figure 16 Setting the Number Of Batteries In Series

12.11 VSET(Battery Type Setting)

IP5385 sets the battery type by outputting 80μA current to the resistor connected to GND on the GPIO4 PIN and judging the voltage on the GPIO4, thereby changing the battery display threshold, the constant voltage for charging the battery, and the protection voltage. The different resistances to GND connected to GPIO4 and the corresponding different battery types are shown in the following table. When the voltage of GPIO4 exceeds all judgment ranges, the chip will recognize the circuit as a short circuit or an abnormal open circuit.

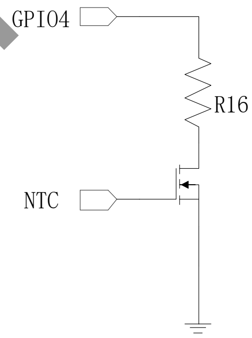


Table 10 Battery Type Setting

Resistance from GPIO4 to GND	GPIO4 (Theoretical Voltage)	GPIO4 Voltage Judgment Range	Corresponding Battery Type
27 kΩ	2160 mV	1750 mV ~2550 mV	4.2V
18 kΩ	1440 mV	1220 mV ~1750 mV	4.3V
13 kΩ	1040 mV	860 mV ~1220 mV	4.35V
9.1 kΩ	728 mV	600 mV ~860 mV	4.4V
6.2 kΩ	496 mV	384 mV ~600 mV	4.15V

3.6 kΩ	288 mV	216 mV ~384 mV	3.65V

Note:

1. 3.65V refers to lithium iron phosphate battery and corresponding turn-off voltage is 2.75V.
2. Note that the accuracy of the external resistance should be 1% and the voltage of GPIO4 should be in the middle of the judgment range.

12.12 NTC Function and Threshold Selection

IP5385 integrates NTC function, which can detect battery temperature. When the IP5385 is working, a constant current source is generated at the NTC pin, and an external NTC resistor is used to generate a voltage.The IC internally detects the voltage of the NTC pin to determine the current battery temperature.

*Connect a 100nF capacitor in parallel with the NTC PIN to GND, the capacitor needs to be placed close to the chip PIN.

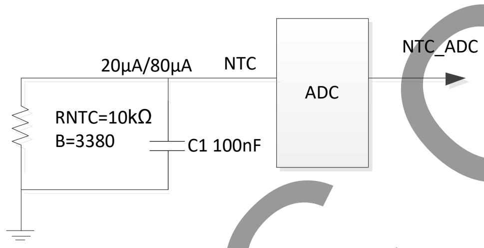


Figure 17 NTC Circuit

IP5385 discharges 80μA current on the LED1 PIN. If this PIN is connected with different resistors, different voltages can be obtained. The IC will detect the LED1 voltage and select different NTC functions according to the LED1 voltage. When the voltage of LED1 exceeds all judgment ranges, the chip will recognize the circuit as a short circuit or an abnormal open circuit.

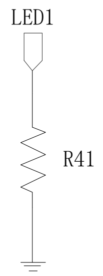


Figure 18 NTC Threshold Selection

LED1 External Resistance	LED1 Theoretical Voltage	LED1 Voltage Judgment Range	NTC Function
27 kΩ	2160 mV	1750 mV~2550 mV	NTC first gear
18 kΩ	1440 mV	1220 mV~1750 mV	NTC second gear
13 kΩ	1040 mV	860 mV~1220 mV	NTC third gear
9.1 kΩ	728 mV	600 mV~860 mV	NTC fourth gear
6.2 kΩ	496 mV	380 mV~600 mV	NTC fifth gear
3.6 kΩ	288 mV	216 mV~380 mV	NTC sixth gear

Table 11 NTC Threshold Selection

Note that the accuracy of the external resistance should be 1% and the voltage of LED1 should be in the middle of the judgment range.

IP5385 has six built-in NTC functions. By changing the resistance between LED1 PIN and GND, the corresponding NTC function can be set. The functions are as follows:

NTC first gear:

In the charging state,charging stops when the NTC temperature is lower than 0°C (0.55V), normal charging between 0 and 45°C, and charging stops when the NTC temperature is higher than 45°C (0.39V).

In the discharge state,discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 60°C, and the discharge is stopped when the NTC temperature is higher than 60°C (0.24V).

NTC second gear:

In the charging state, charging stops when the NTC temperature is lower than 2°C (0.50V), normal charging between 2°C and 43°C, and charging stops when the NTC temperature is higher than 43°C (0.42V).

In the discharge state, discharge is stopped when the NTC temperature is lower than -10°C (0.86V), normal discharge is between -10°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

NTC third gear:

In the charging state, charging stops when the NTC temperature is lower than 0°C (0.55V), normal charging between 0 and 45°C, and charging stops when the NTC temperature is higher than 45°C (0.39V).

In the discharge state, discharge is stopped when the NTC temperature is lower than -10°C (0.86V), normal discharge is between -10°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

NTC fourth gear:

In the charging state, when the NTC temperature is lower than -10°C (0.86V), the charging stops, the current limit of the BAT terminal is 0.2C between -10°C ~0°C, and C is equal to the battery capacity set by FCAP, and the normal charging is between 0°C and 45°C (0.39V). Between 45°C and 55°C, the constant voltage charging voltage is reduced by 0.1V*N to charge the battery with normal current, and the NTC temperature is higher than 55°C (0.28V) to stop charging.

In the discharge state, discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

NTC fifth gear:

In the charging state, when the NTC temperature is lower than 2°C (0.50V), the charging stops, the current limit of the BAT terminal is 0.1C between 2°C and 17°C, and C is equal to the battery capacity set by FCAP, and the normal charging is between 17 and 43°C (0.42V). and the NTC temperature is higher than 43°C to stop charging.

In the discharge state, discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 60°C, and the discharge is stopped when the NTC temperature is higher than 60°C (0.24V).

NTC sixth gear:

In the charging state, When the NTC temperature is lower than -10°C (0.86V), the charging stops, the current limit of the BAT terminal is 0.2C between -10°C and 0°C (0.55V), and the charging is normal between 0 °C and 45°C. the BAT terminal current is limited to 0.2C for charging between 45°C ~55°C

(0.28V), C is equal to the battery capacity set by FCAP, and the NTC temperature is higher than 55℃ (0.28V) to stop charging.

In the discharge state, discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

*Note:

After detecting the abnormal temperature of the NTC, it resumes normal operation when the temperature is ±5 degrees Celsius of the protection temperature. In the brackets after the above temperature, the NTC PIN voltage corresponding to the temperature is written. The calculation method is: the current discharged by the NTC PIN * the NTC resistance value at the temperature.

The NTC resistance parameter referenced in the above temperature range is 10kΩ@25℃ B=3380. Other models are different and need to be adjusted.

If the scheme does not require NTC, the NTC pin should be connected to the ground with a 10kΩ resistor, and cannot be left floating or grounded directly.

13 Layout considerations

13.1 VIO and BAT Terminal Sampling Lines

In the schematic diagram, BAT and CSP2 belong to the same network, but they must go to the 5mΩ sampling resistor end respectively when routing. Similarly, CSN2 and PCON also need to go to the 5mΩ sampling resistor end respectively.

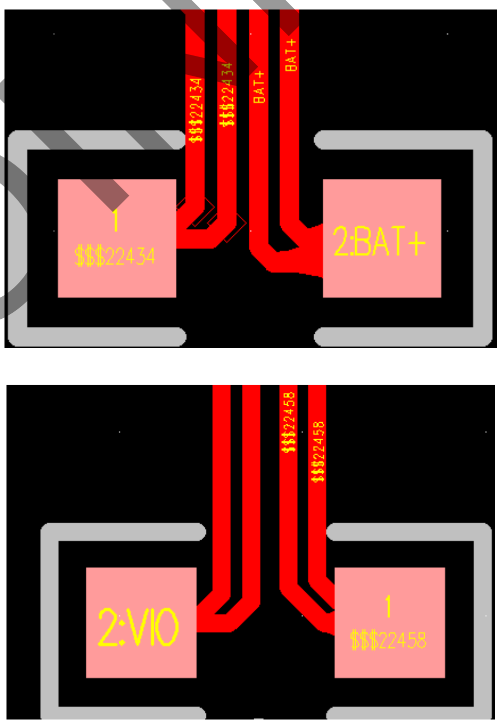


Figure 19 5mΩ Resistance Sampling Line

13.2 VIO and BAT Capacitors

The VIO and BAT terminal capacitors need to be close to the sampling resistor, and the ground of the capacitor needs to be close to the ground of the lower tube of the H-bridge, and as many vias as possible should be made. For example: BAT terminal capacitor location.

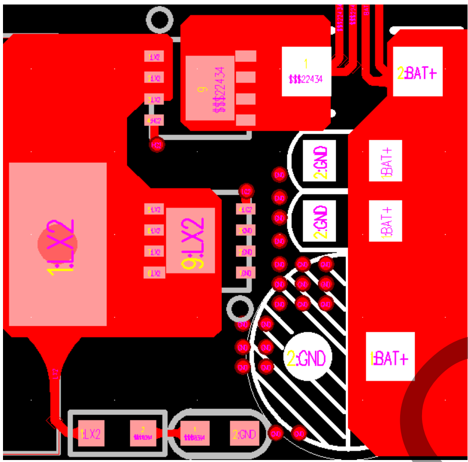


Figure 20 BAT Capacitors

13.3 The Wiring from VIO to output USB-A1, USB-A2 MOS Tube

The wiring from VIO to USB-A1 and USB-A2 output MOS needs to be routed separately at the VIO of the VBUS_I resistor, otherwise it may affect the automatic recovery fast charging function when multi-port to single-port.

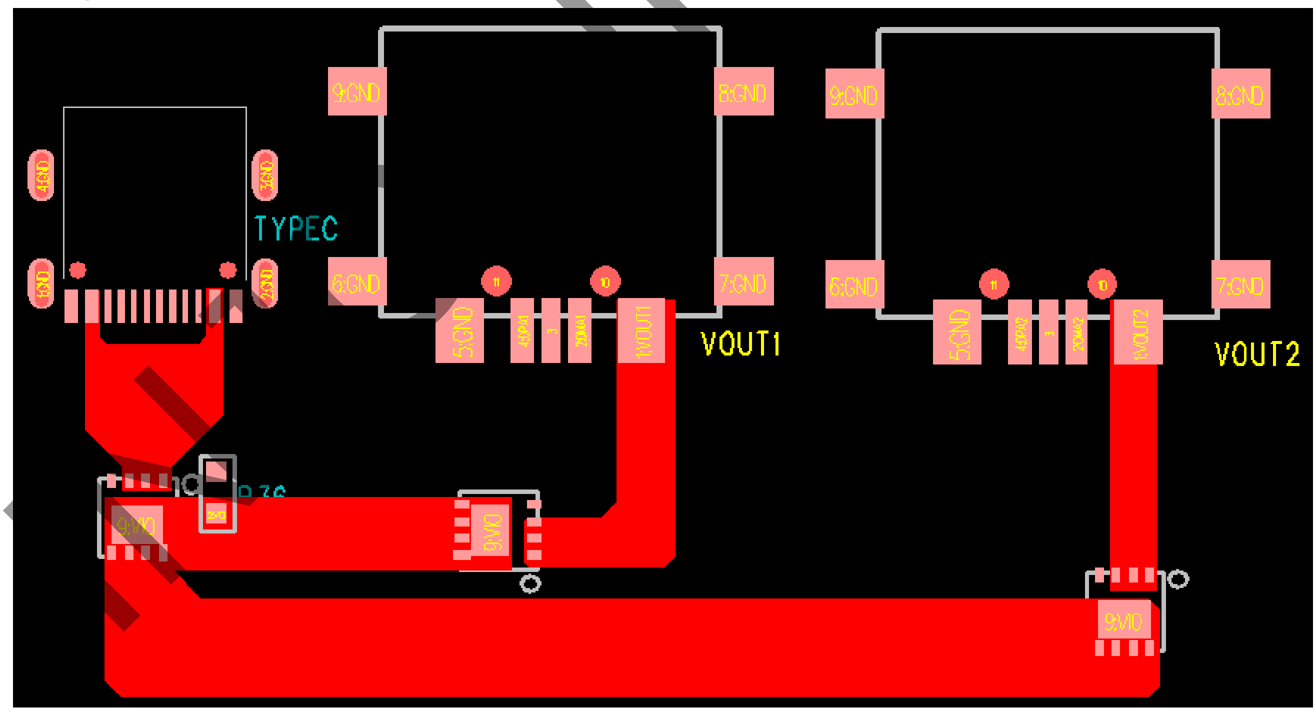
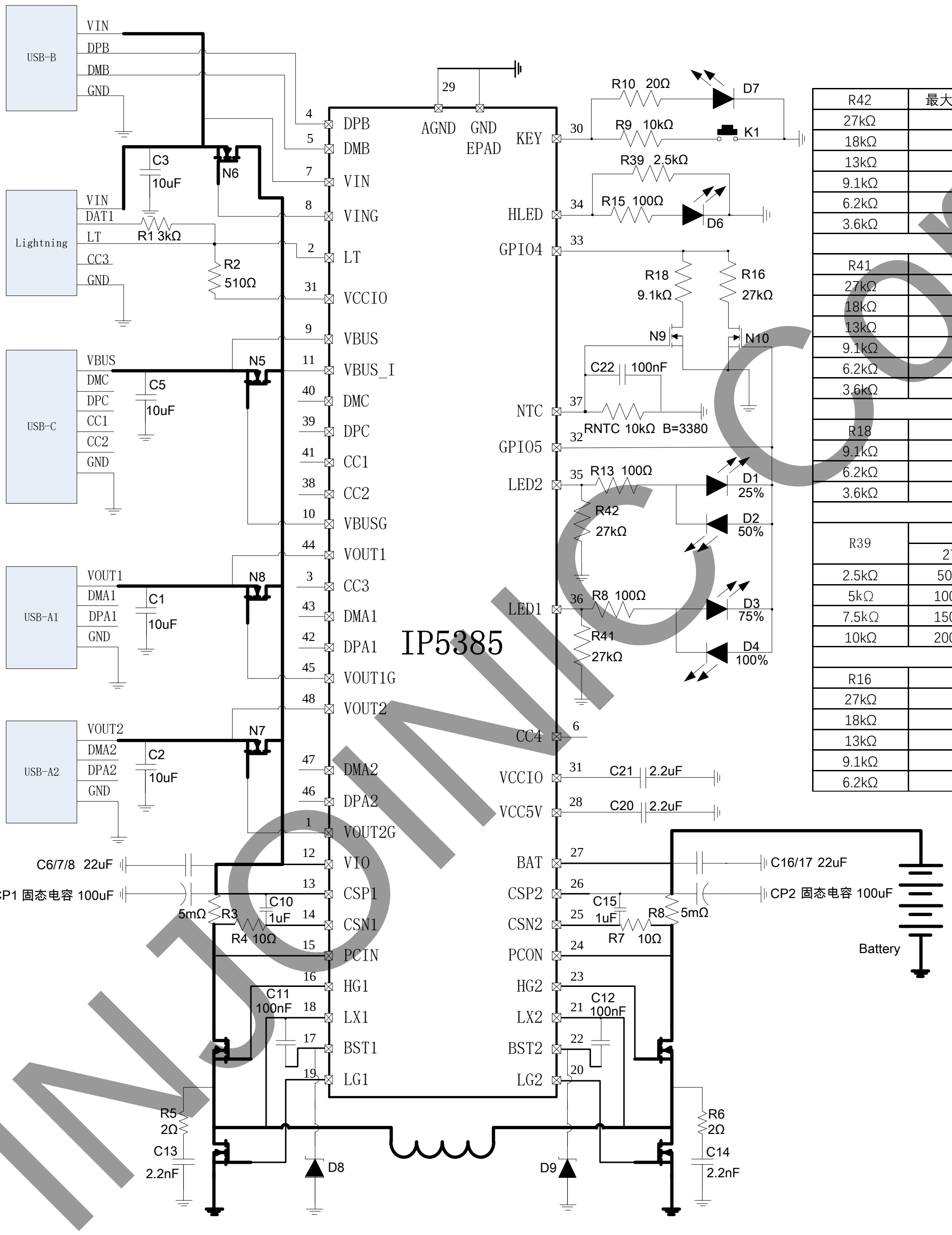


Figure 21 Route The VIO To Each Output Port

14 Application Schematic

14.1 Application Schematic Diagram of LED Lamp Scheme



R42	最大输入功率	最大输出功率
27kΩ	65W	65W
18kΩ	60W	60W
13kΩ	45W	45W
9.1kΩ	35W	35W
6.2kΩ	30W	30W
3.6kΩ	20W	30W

R41	NTC_MODE
27kΩ	NTC六档
18kΩ	NTC五档
13kΩ	NTC四档
9.1kΩ	NTC三档
6.2kΩ	NTC二档
3.6kΩ	NTC一档

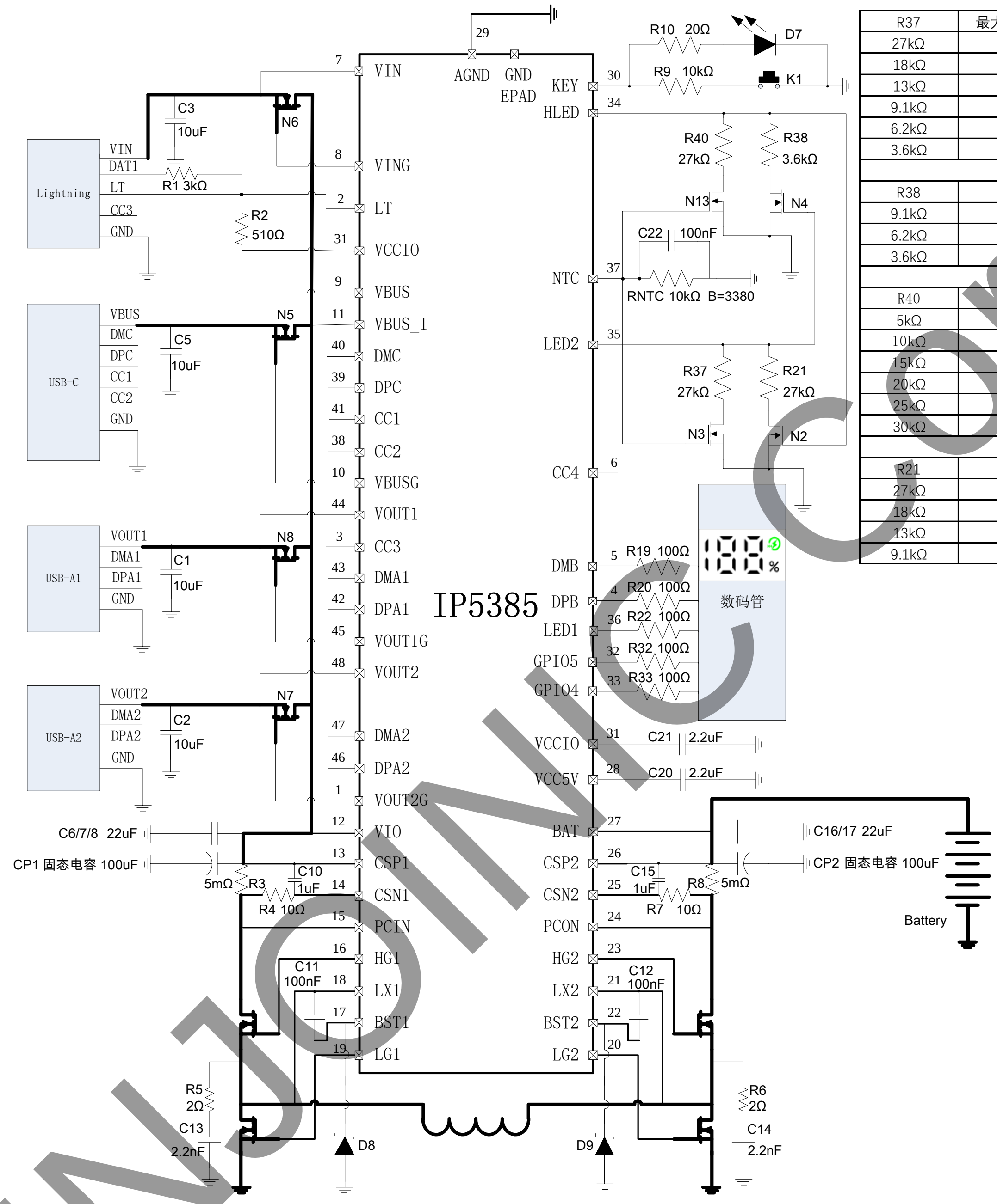
R18	对应设定的电芯串数
9.1kΩ	4串
6.2kΩ	3串
3.6kΩ	2串

R39	对应设定的电芯容量	
	2节电池	3~4节电池
2.5kΩ	5000mAH	2500mAH
5kΩ	10000mAH	5000mAH
7.5kΩ	15000mAH	7500mAH
10kΩ	20000mAH	10000mAH

R16	对应电池类型
27kΩ	4.2V
18kΩ	4.3V
13kΩ	4.35V
9.1kΩ	4.4V
6.2kΩ	4.15V

Figure 22 IP5385 LED Lamp Scheme Application Schematic Diagram

14.2 Digital Tube Solution Application Schematic Diagram



R37	最大输入功率	最大输出功率
27kΩ	65W	65W
18kΩ	60W	60W
13kΩ	45W	45W
9.1kΩ	35W	35W
6.2kΩ	30W	30W
3.6kΩ	20W	30W

R38	对应设定的电芯串数
9.1kΩ	4串
6.2kΩ	3串
3.6kΩ	2串

R40	对应设定的电芯容量
5kΩ	5000mAH
10kΩ	10000mAH
15kΩ	15000mAH
20kΩ	20000mAH
25kΩ	25000mAH
30kΩ	30000mAH

R21	对应电池类型
27kΩ	4.2V
18kΩ	4.3V
13kΩ	4.35V
9.1kΩ	4.4V

Figure 23　Digital Tube Solution Application Schematic Diagram

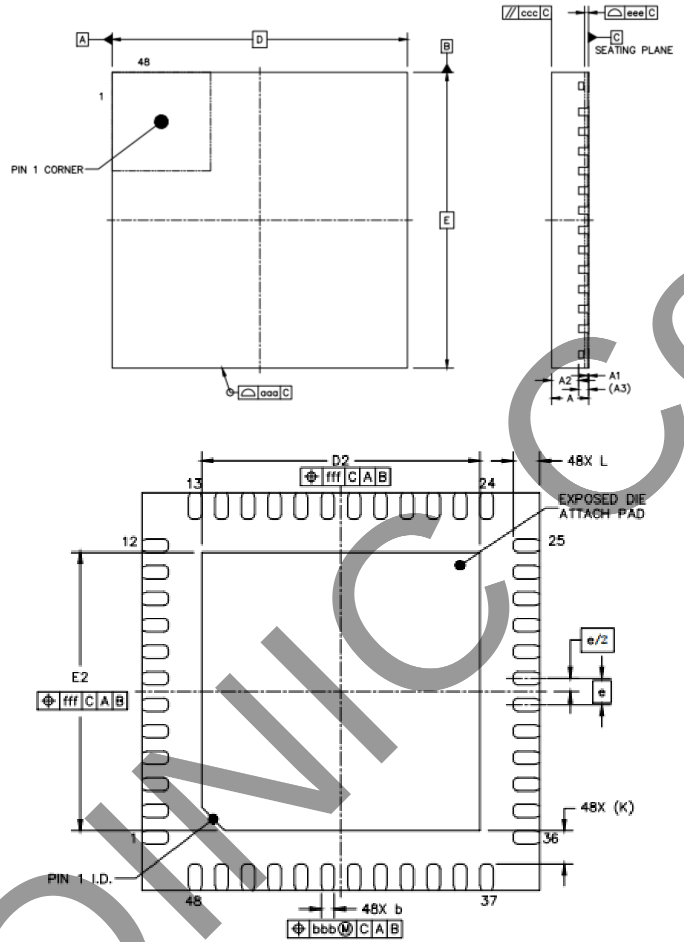
BOM

Serial number	Part name	Type	Location	Number	Remarks
1	SMT IC	QFN48 IP5385	U1	1	
2	SMT capacitor	0603 100nF 10% 50V	C11 C12	2	
3	SMT capacitor	0603 1μF 10% 16V	C10 C15	2	
4	SMT capacitor	0603 2.2μF 10% 16V	C20 C21	2	
5	SMT capacitor	0805 10μF 10% 25V	C1 C2 C3 C5	4	
6	SMT capacitor	0805 22μF 10% 25V	C6 C7 C8 C16 C17	5	
7	SMT capacitor	0603 2.2nF 10% 50V	C13 C14	2	
8	CPAE capacitor	100μF 35V 10%	CP1 CP2	2	
9	Inductor	4.7μH SPA1265-4R7	L1	1	
10	SMT NMOS	R_{DS}<10mΩ, V_{DS}>30V, V_{GS}>12V, I_D>15A, C_{iss}<1200pF	H-bridge NMOS	4	
11	TVS	30V TVS V_{RWM}>30V, V_{CL}<50V, I_{PPM}>8A	D8 D9	2	
12	SMT resistor	0603 0Ω 1%	R36 R43 R44 R45 R46	5	
13	SMT resistor	0603 10Ω 1%	R4 R7	2	
14	SMT resistor	0603 2Ω 1%	R5 R6	2	
15	SMT resistor	1206 0.005Ω 1%	R3 R8	2	ppm<75
16	SMT resistor	0603 2.5kΩ 1%	R39	1	FCAP
17	SMT resistor	0603 9.1kΩ 1%	R18	1	Number of battery
18	SMT resistor	0603 27kΩ 1%	R16	1	Tyoe of battery
19	SMT NMOS	2N7002	N9 N10	2	
20	SMT resistor	0603 27kΩ 1%	R42	1	PMAX
21	SMT resistor	0603 3.6kΩ 1%	R41	1	NTC_MODE
22	SMT capacitor	0603 100nF 10% 50V	C22	1	NTC
23	NTC thermal resistor	10kΩ@25℃ B=3380	RNTC	1	
24	SMT resistor	0603 100Ω 1%	R13 R14 R15	4	LED Lamp Scheme Application
25	SMT LED	0603 blue	D1 D2 D3 D4	4	
26	SMT LED	0603 red	D6	1	
27	SMT resistor	0603 0Ω 1%	R34 R35	2	
28	Digital tube	YFTD1508SWPG-5D	SMG1	1	Digital Tube Scheme Application
29	SMT resistor	0603 100Ω 1%	R19 R20 R22 R32 R33	5	

30	LED	5MM LED	D7	1	lighting circuit
31	SMT resistor	0603 20Ω 1%	R10	1	
32	SMT resistor	0603 10kΩ 1%	R9	1	keys module
33	KEY	SMT 3*6	SW	1	
34	SMT NMOS	$R_{DS}<15m\Omega$，$V_{DS}>30V$，$V_{GS}>12V$，$I_D>10AF$	N5 N6 N7 N8	4	
35	Output USB	AF10 8 pins USB	USB1 USB2	2	
36	USB C connector	USB C connector	USB3	1	
37	Lightning connector	Apple lightning connector	USB4	1	Lightning
38	SMT resistor	0603 3kΩ 1%	R1	1	
39	SMT resistor	0603 510Ω 1%	R2	1	

15 Package

15.1 Package of the Chip



		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.7	0.75	0.8
STAND OFF		A1	0	0.02	0.05
MOLD THICKNESS		A2	---	0.55	---
L/F THICKNESS		A3		0.203 REF	
LEAD WIDTH		b	0.15	0.2	0.25
BODY SIZE	X	D		6 BSC	
	Y	E		6 BSC	
LEAD PITCH		e		0.4 BSC	
EP SIZE	X	D2	4.1	4.2	4.3
	Y	E2	4.1	4.2	4.3
LEAD LENGTH		L	0.3	0.4	0.5
LEAD TIP TO EXPOSED PAD EDGE		K		0.5 REF	
PACKAGE EDGE TOLERANCE		aaa		0.1	
MOLD FLATNESS		ccc		0.1	
COPLANARITY		eee		0.08	
LEAD OFFSET		bbb		0.07	
EXPOSED PAD OFFSET		fff		0.1	

15.2 Marking Description

说明：

1、 --Injoinic Logo

2、IP5385 --Product Model

3、XXXXXXXX --Manufacture Number

4、 ○ --Pin1 Location

Figure 24 Silk Screen Printing

16 Important Notice

INJOINIC TECHNOLOGY Corp. and its subsidiaries reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to INJOINIC TECHNOLOGY Corp.'s terms and conditions of sale supplied at the time of order acknowledgment.

INJOINIC TECHNOLOGY Corp. assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using INJOINIC's components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of INJOINIC's components in its applications, notwithstanding any applications-related information or support that may be provided by INJOINIC. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify INJOINIC TECHNOLOGY and its representatives against any damages arising out of the use of any INJOINIC's components in safety-critical applications.

Reproduction of significant portions of INJOINIC's information in INJOINIC's data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. INJOINIC TECHNOLOGY Corp. is not responsible or liable for such altered documentation. Copying information from third parties may be subject to additional restrictions.

INJOINIC will update this document from time to time. The actual parameters of the product may vary due to different models or other items. This document is not a warranty of any kind, express or implied.

Resale of INJOINIC's components or services with statements different from or beyond the parameters stated by INJOINIC for that component or service voids all express and any implied warranties for the associated INJOINIC's component or service and is an unfair and deceptive business practice. INJOINIC TECHNOLOGY Corp. is not responsible or liable for any such statements.