# Support SCP, Bi-directional PD3.0 , Fast Charge protocol , Wireless charging automatic wake-up Power Bank SOC

## 1. Features

- **Support multiple ports simultaneously**
  - ✧ 1 USB A output ports
  - ✧ 1 USB C input / output port
  - ✧ Wireless charging TX
  - ✧ Support wireless charging, USB output or input work simultaneously
- **WPC QI compliant**
  - ✧ Supports BPP, PPDE, EPP protocols
- **Wireless charging**
  - ✧ Support 5W/7.5W/10W/15W TX
  - ✧ External full-bridge power MOS
  - ✧ Integrated ASK communication demodulation module
  - ✧ Support CBB/NPO capacitor
- **Integrated wireless charging function**
  - ✧ Support no-load and on-load foreign object detection
  - ✧ Support coil NTC temperature detection
  - ✧ Support coil voltage maximum amplitude Limit
  - ✧ Support wireless charging automatic wake up
- **Fast charge**
  - ✧ Every port support fast charge
  - ✧ Support QC2.0 / QC3.0 output
  - ✧ Support FCP / AFC input / output
  - ✧ Support high voltage SCP output
  - ✧ Support USB C DRP input / output
  - ✧ Support BC1.2 / Apple / Samsung
  - ✧ PDO：5V@3A、9V@2.22A、12V@1.67A 3.3V~11V@2A
- **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 3.3~11V adjustable voltage with 20mV / Step
  - ✧ Support BMC protocol
  - ✧ Integrated PHY Protocol
  - ✧ Integrated Hardware CRC
  - ✧ Support Hard Reset
- **Charger**
  - ✧ Support 18W charging power, Up to 5A charging current at battery port
  - ✧ Adaptive charging current adjustment
  - ✧ Support 4.20V、4.30V、4.35V、4.40V battery
- **Boost**
  - ✧ Output current:
  - ✧ 5V@3.1A 9V@2.22A 12V@1.67A
  - ✧ Up to 94%@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
  - ✧ Supports battery capacity selection
- **Others**
  - ✧ Support auto detect of plug in and out
  - ✧ Fast charge status indicator
  - ✧ Support Battery NTC
  - ✧ Enter standby mode automatically in light load
  - ✧ Support I2C
- **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**

## 3. Description

IP5561 is a power management SOC compliant with the WPC QI standard. It integrates wireless charging and QC2.0/ QC3.0/SCP output fast charging protocol, FCP/ AFC input and 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 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. one USB A 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 IP5561 can provide the maximum output capacity of 22.5W. When boost has no load, it will automatically enter the sleep mode.

IP5561 supports 18W charging and charging current up to 5.0A. Built in IC temperature, battery temperature and input voltage control loop, intelligent regulation of charging current.

IP5561 internally integrates H-bridge driver module, ASK communication demodulation module and other necessary wireless charging resources.

IP5561 integrates a 14bit ADC and current sensing circuit, which can accurately measure battery voltage and current. The algorithm of remaining battery capacity of IP5561 can accurately obtain battery level information. The battery capacity can be seted to accurately display the remaining battery capacity.

IP5561 supports1/2/4LED battery level indicator, and 88/188 digital tube battery level indicator. IP5561 supports lightning function and supports buttons.

# Contents





# 4. Reversion History

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

| Change to Reversion V1.00 (Oct 2023) | Page |
|---|---|
| ● Preliminary release | 1 |

| Change version V1.00 to V1.10 (Jan 2024) | Page |
|---|---|
| ● Added wireless charge automatic wake up description | 1 |
| ● Schematic update | 35 |

| Change version V1.10 to V1.11 (Feb 2024) | Page |
|---|---|
| ● Schematic diagram adds lithium protection circuit | 35 |
| ● Electrical characteristics increase standby current of automatic wake up scheme | 13 |

| Change version V1.11 to V1.12 (Mar 2024) | Page |
|---|---|
| ● Added the FOD threshold PIN | 31 |
| ● Adding I2C applications | 31 |

| Change version V1.12 to V1.20 (June 2024) | Page |
|---|---|
| ● Schematic adds OVP circuit | 31 |

## 5. Typical Application

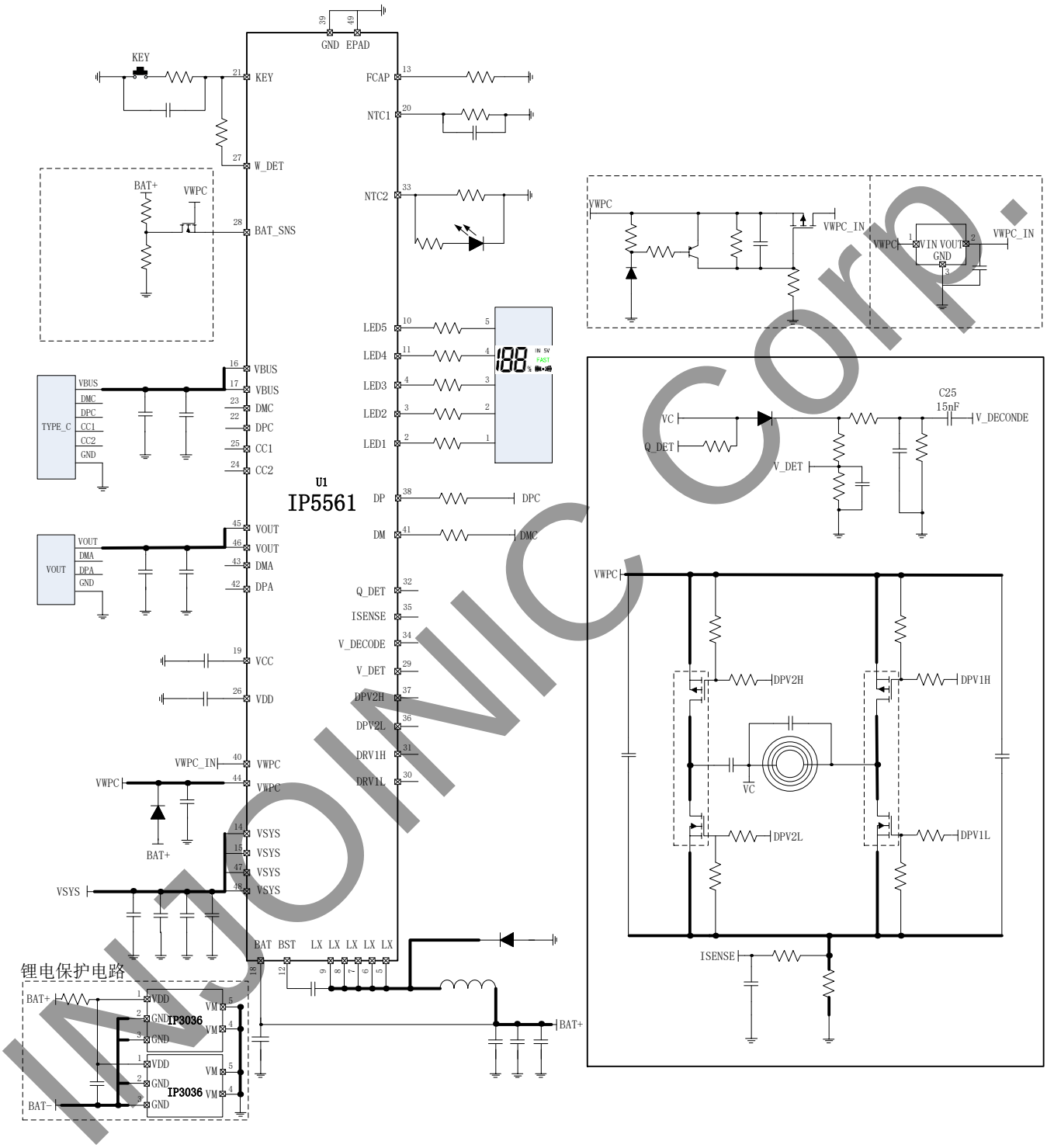



Figure 1 Simplified Application



# 6. IP Series Products List

## 6.1. Power Bank IC

| IC Part No. | Charge/Boost Power | | Main feature | | | | | | | | Package | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boost Power | Charge Power | LED number | I2C | DCP | USB C | QC | PD3.0 /PPS | Super charge | UFCS | Package | Compatibility |
| IP5303T | 5V/1A | 5V/1A | 1,2 | - | - | - | - | - | - | - | ESOP8 | PIN2PIN |
| IP5305T | 5V/1A | 5V/1A | 1,2,3,4 | √ | - | - | - | - | - | - | ESOP8 | |
| IP5306 | 5V/2.4A | 5V/2A | 1,2,3,4 | √ | - | - | - | - | - | - | ESOP8 | |
| IP5306H | 5V/2.4A | 5V/2A | 1,2,3,4 | √ | - | - | - | - | - | - | ESOP8 | |
| IP5306P | 5V/2.1A | 5V/2A | 1,2,4 | √ | - | - | - | - | - | - | ESOP8 | |
| IP5316 | 5V/2.4A | 5V2.4A | 1,2,4 | √ | √ | √ | - | - | - | - | ESSOP10 | |
| IP5326 | 5V/2.4A | 5V2.4A | 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 | √ | √ | √ | - | QFN32 | |
| IP5356 | 22.5W | 18W | Nixie Tube | √ | √ | double | √ | √ | √ | - | QFN40 | PIN2PIN |
| IP5356H | 22.5W | 18W | Nixie Tube | √ | √ | double | √ | √ | √ | - | QFN40 | |
| IP5356M | 22.5W | 18W | Nixie Tube | √ | √ | double | √ | √ | √ | - | QFN40 | |
| IP5358 | 22.5W | 18W | Nixie Tube | - | √ | √ | √ | √ | √ | - | QFN48 | |
| IP5561 | 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 | √ | √ | √ | √ | QFN48 | |
| IP5386 | 45W | 45W | Nixie Tube | √ | √ | double | √ | √ | √ | - | QFN48 | |
| IP5389 | 100W | 100W | Nixie Tube | √ | √ | double | √ | √ | √ | - | QFN64 | |
| IP5389H | 100W | 100W | Nixie Tube | √ | √ | double | √ | √ | √ | - | QFN64 | |

# 7. PIN Configuration and Functions

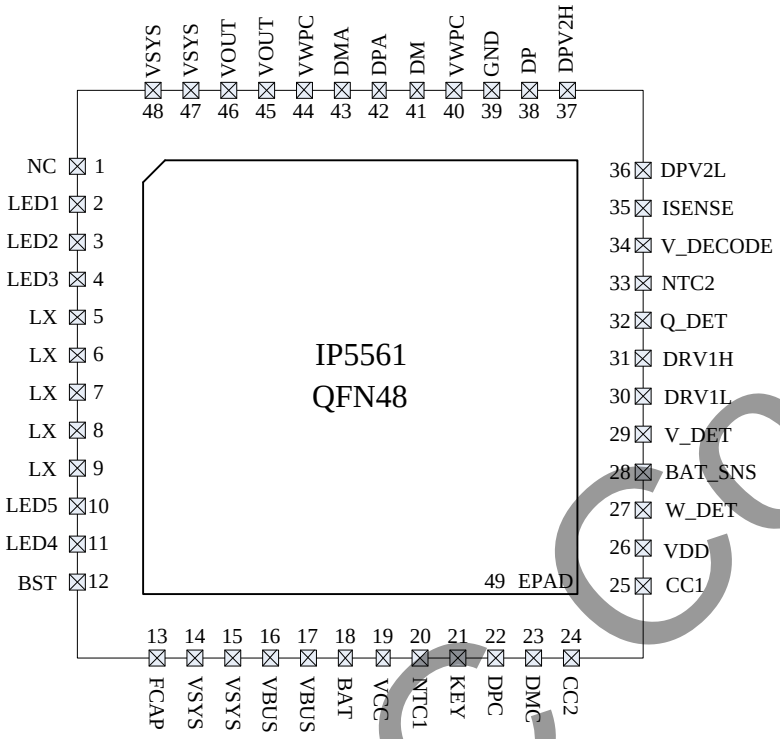



Figure 2 IP5561 48-Pin Top View

## 7.1. IP5561 Pin Functions

| Pin Num | Pin Name | DESCRIPTION |
|---|---|---|
| 1 | NC | NC |
| 2 | LED1 | Battery level display drive PIN LED1 |
| 3 | LED2 | Battery level display drive PIN LED2 |
| 4 | LED3 | Battery level display drive PIN LED3 |
| 5、6、7、8、9 | LX | DCDC switch node, connect to inductor |
| 10 | LED5 | Battery level display drive PIN LED5 |
| 11 | LED4 | Battery level display drive PIN LED4 |
| 12 | BST | Internal high voltage drive, serial capacitor to LX |
| 13 | FCAP | Capacity external setting PIN |
| 14、15、47、48 | VSYS | Public Node of system power input and output |
| 16、17 | VBUS | USB typec port power PIN |
| 18 | BAT | Battery supply PIN |
| 19 | VCC | 3.3V Voltage output PIN |
| 20 | NTC1 | NTC1 PIN |

| | | |
|---|---|---|
| 21 | KEY | KEY detect PIN |
| 22 | DPC | VBUS port DP PIN |
| 23 | DMC | VBUS port DM PIN |
| 24 | CC2 | VBUS port CC2 PIN |
| 25 | CC1 | VBUS port CC1 PIN |
| 26 | VDD | Wireless charging digital circuit power PIN |
| 27 | W_DET | Wireless charge load signal detection PIN |
| 28 | BAT_SNS | Battery voltage sampling PIN |
| 29 | V_DET | Coil voltage detection PIN |
| 30 | DRV1L | DRV1 lower tube driver PIN |
| 31 | DRV1H | DRV1 upper tube driver PIN |
| 32 | Q_DET | Q Quantity detection PIN |
| 33 | NTC2 | NTC2/display drive PIN |
| 34 | V_DECODE | Voltage decoding input PIN |
| 35 | ISENSE | Current sampling input PIN |
| 36 | DPV2L | DRV2 lower tube driver PIN |
| 37 | DPV2H | DRV2 upper tube drive PIN |
| 38 | DP | Wireless charging DP PIN |
| 39 | GND | System and power ground |
| 40 | VWPC | Wireless charging power supply PIN |
| 41 | DM | Wireless charging DM PIN |
| 42 | DPA | VOUT port DP PIN |
| 43 | DMA | VOUT port DM PIN |
| 44 | VWPC | Wireless charging power supply PIN |
| 45、46 | VOUT | VOUT output port power PIN |
| 49(EPAD) | GND | System and power ground |

# 8. Functional Block Diagram

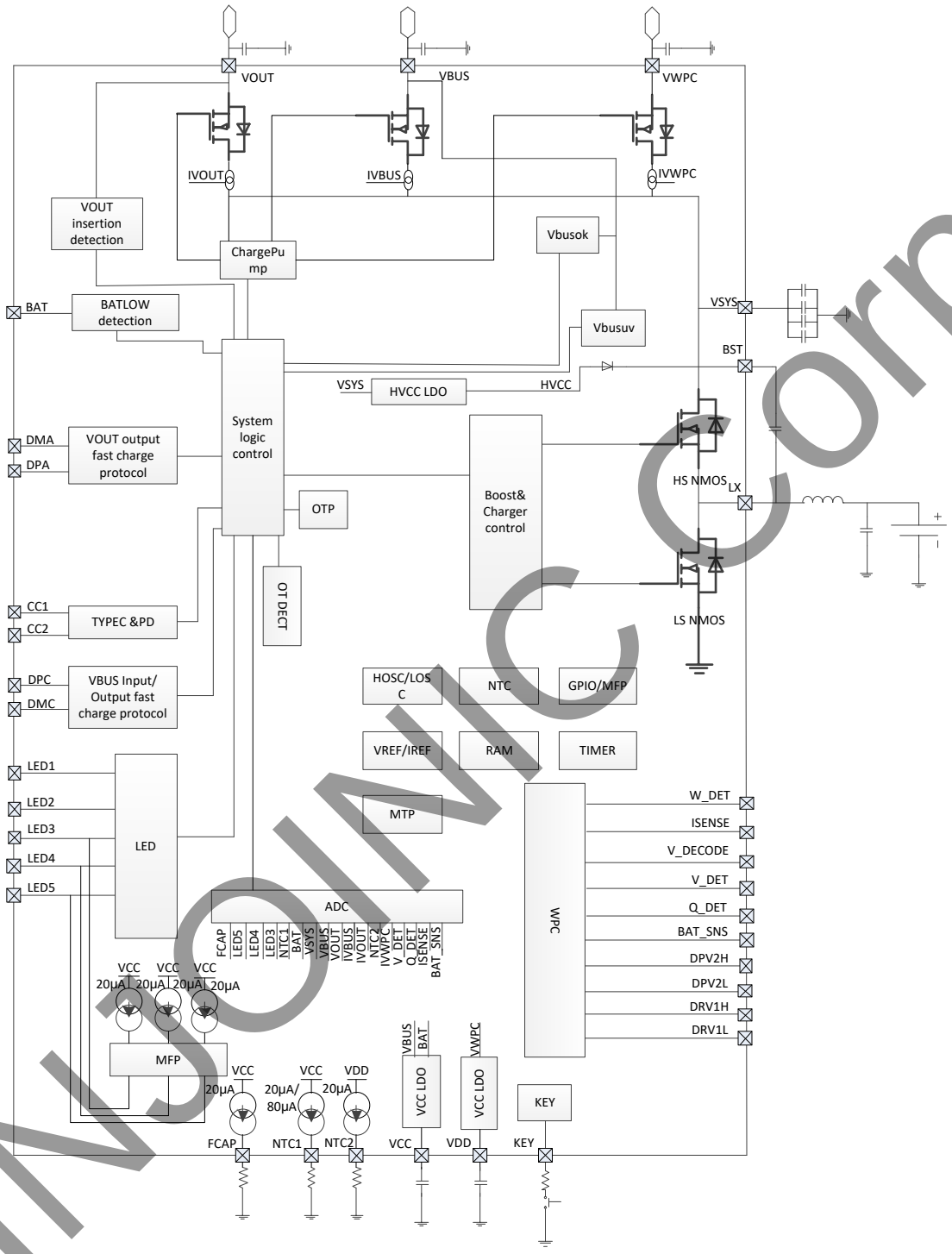



Figure 3 Functional Block Diagram

## 9. Absolute Maximum Ratings

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

*Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device.

Exposure to Absolute Maximum Rated conditions for extended periods may affect device reliability.

*Voltages are referenced to GND unless otherwise noted.

## 10. Recommended Operating Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Input Voltage | $V_{BUS}$ | 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.

## 11. 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 | $V_{BUS}$ | | 4.5 | 5/9/12 | 14.0 | V |
| Input Over Voltage | $V_{BUS}$ | | 14.0 | 14.5 | 15.0 | V |
| Constant Charge Voltage | $V_{TRGT}$ | $V_{SET}$=4.20V | 4.18 | 4.22 | 4.25 | V |
| | | $V_{SET}$=4.30V | 4.28 | 4.32 | 4.35 | V |
| | | $V_{SET}$=4.35V | 4.33 | 4.37 | 4.39 | V |
| | | $V_{SET}$=4.40V | 4.38 | 4.42 | 4.45 | V |
| | | $V_{BUS}$ =5V | 2.5 | 2.9 | 3.3 | A |
| | | $V_{BUS}$ >=9V | 1.7 | 2.0 | 2.3 | A |
| Trickle Charge Current | $I_{TRKL}$ | $V_{BUS}$=5V，$V_{BAT}$=2.0V | 20 | 50 | 100 | mA |
| | | $V_{BUS}$=5V, $V_{BAT}$<2.5V | 50 | 200 | 450 | mA |
| Trickle Charge Stop Voltage | $V_{TRKL}$ | | 2.9 | 3.0 | 3.1 | V |
| Charge Stop Current | $I_{STOP}$ | 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 |
| 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 $V_{OUT}$ | @1A | 4.95 | | 12.45 | V |
| | QC3.0 Step | | | 200 | | mV |
| Output voltage ripple | $\Delta V_{OUT}$ | $V_{BAT}$=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 | | 2.22 | | A |
| | | $V_{OUT}$=12V | | 1.67 | | A |
| Boost efficiency | $\eta_{out}$ | $V_{BAT}$=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 | 2.60 | 2.90 | 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 | 30 | 60 | 100 | mA |
| Load overcurrent detect time | $T_{UVD}$ | Duration of output voltage under 4.2V, | | 30 | | ms |
| Load short circuit detect time | $T_{OCD}$ | Duration of output current above 4.4A | 150 | | 200 | μs |
| **Control System** | | | | | | |
| Switch frequency | fs | Discharge switch frequency | 350 | 400 | 450 | kHz |
| | | Charge switch frequency | 630 | 680 | 730 | 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 |
| VDD output voltage | $V_{DD}$ | $V_{WPC}$=5V | | 4.8 | | V |
| Battery port standby current | $I_{STB1}$ | $V_{BUS}$=0V, VBAT=3.7V, average current | | 80 | 200 | μA |
| | $I_{STB2}$ | Wireless charge wakes up automatically,$V_{BUS}$=0V,VBAT=3.7V, average current | | 150 | 300 | μA |
| VCC output current | $I_{VCCLDO}$ | VBAT=3.7V | 40 | 50 | 60 | mA |
| VDD output current | $I_{VDDLDO}$ | VWPC=5V | 40 | 50 | 60 | mA |
| LED display driving current | $I_{LED1}$ $I_{LED2}$ | Voltage decrease 10% | | 3 | | mA |



| | | | | | | |
|---|---|---|---|---|---|---|
| | $I_{LED3}$ | | | | | |
| Total load Light load shut down detect time | $T1_{load}$ | The load current is consistently less than 60mA | 25 | 32 | 44 | s |
| Output port light load shut down detect time | $T2_{load}$ | 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 |
| Thermal shut down temperature | $T_{OTP}$ | Rising temperature | 130 | 140 | 150 | ℃ |
| Thermal shut down hysteresis | $\Delta T_{OTP}$ | | | 40 | | ℃ |

# 12. Function Description

## 12.1. Low power lock out and activation

When the IP5561 is connected to the battery for the first time, the chip is locked, and the lowest point of the power lamp or the digit of the digital tube flashes five times; In the non-charging state, if the battery voltage is too low to trigger a low-power shutdown, the IP5561 will enter the locked state.

In order to reduce static power consumption, the IP5561 does not support the phone insertion detection function when the chip is locked, nor can it be activated by pressing a button. At this time, the key action cannot activate the boost output, and the lowest level of the battery light or the digit of the digital tube flashes five times to prompt.

When the chip is in the locked state, the chip function can be activated by charging.

## 12.2. Charge

IP5561 integrated trickle, constant current, constant voltage charge management system.IP5561 adopt 680khz synchronous switching charging technology to support different charging voltages.

When the battery voltage is lower than 3V, trickle charging 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.

IP5561 supports charging the battery and phone at the same time,output voltage is 5V.

## 12.3. Boost

IP5561 Integrated a synchronized switch converter which supports high voltage output, providing 3.3V ~ 12V output voltage output, load capacity can be: 5V@3.1A, 9V@2.22A and 12V@1.67A. 400kHz 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.

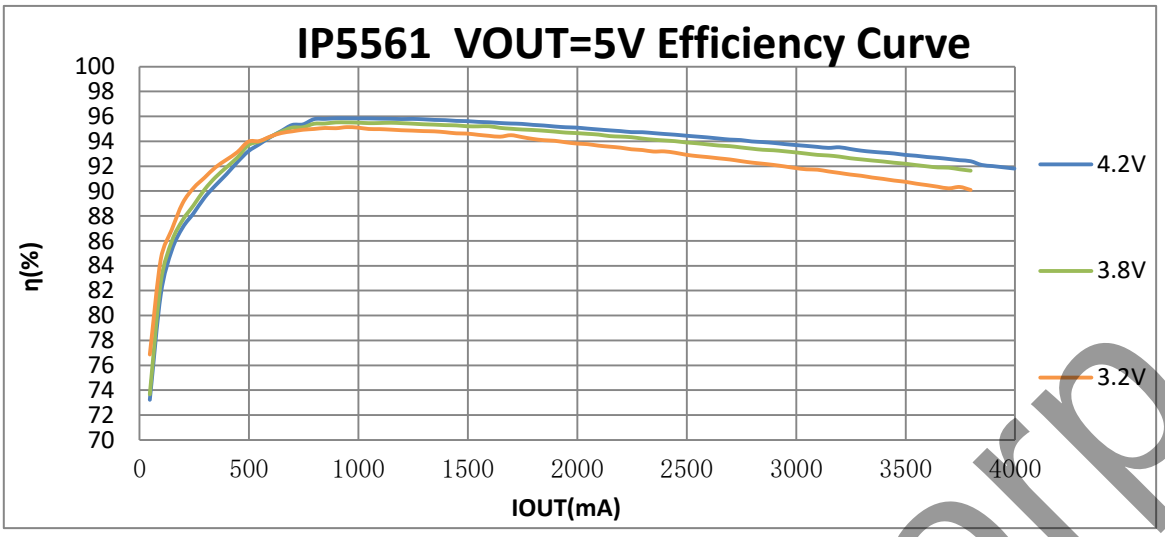



Figure 4 IP5561 VOUT=5V Efficiency Curve

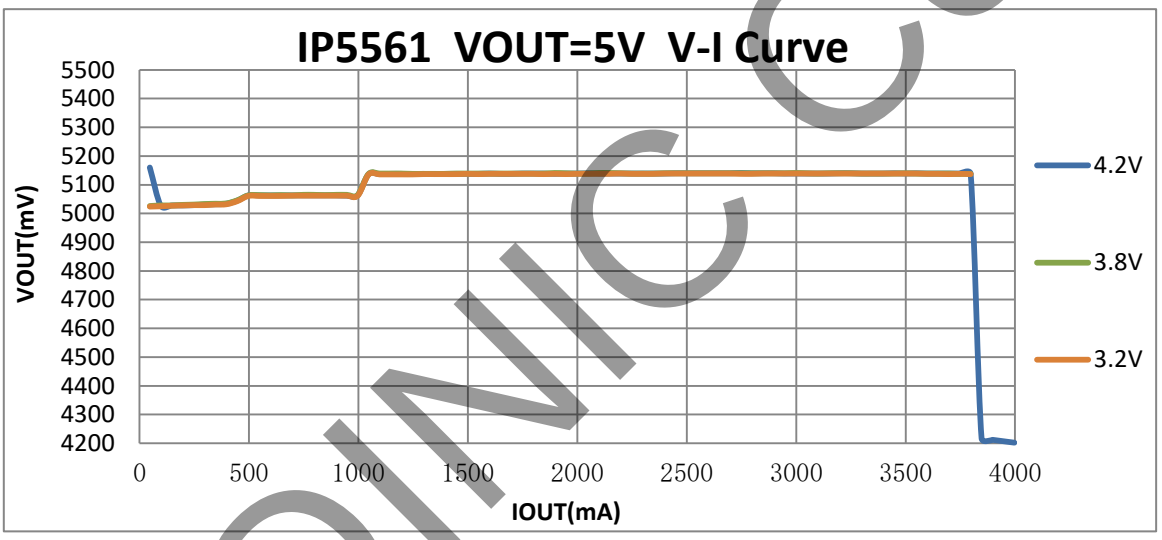



Figure 5 IP5561 VOUT=5V V-I Curve

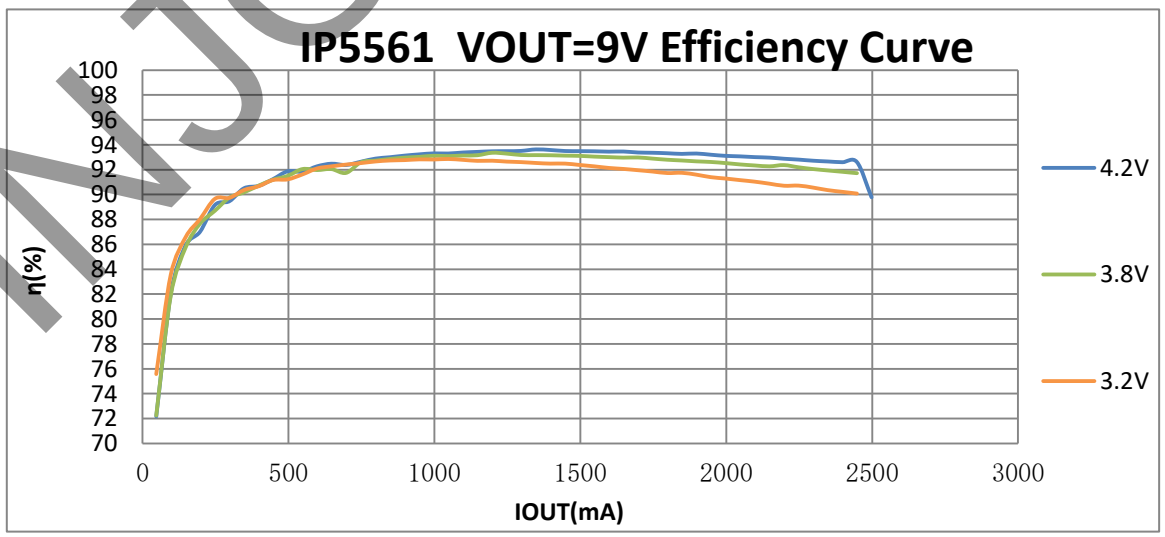



Figure 6 IP5561 VOUT=9V Efficiency Curve

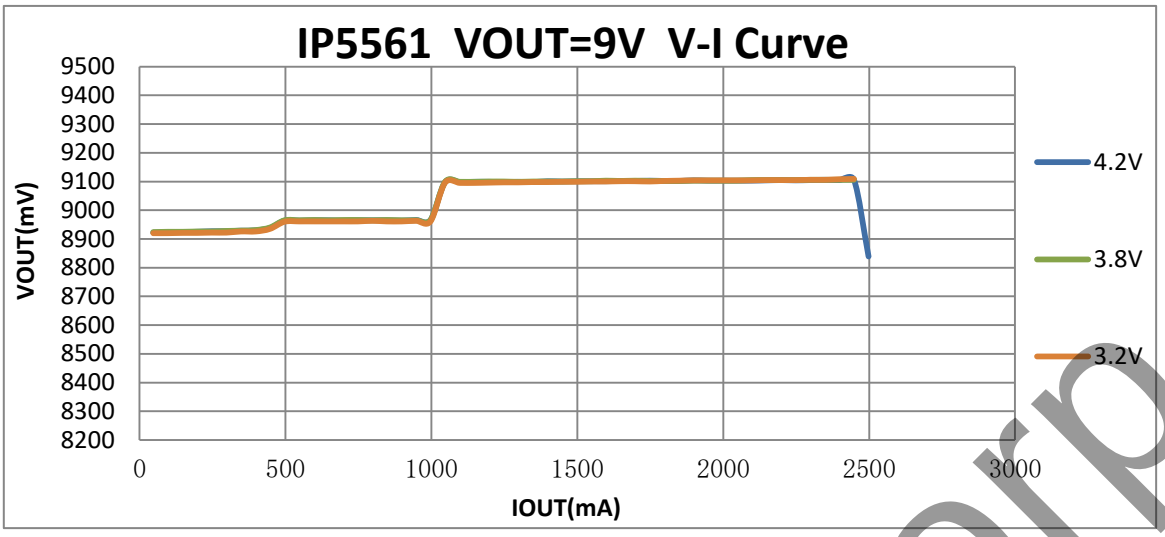



Figure 7 IP5561 VOUT=9V V-I Curve

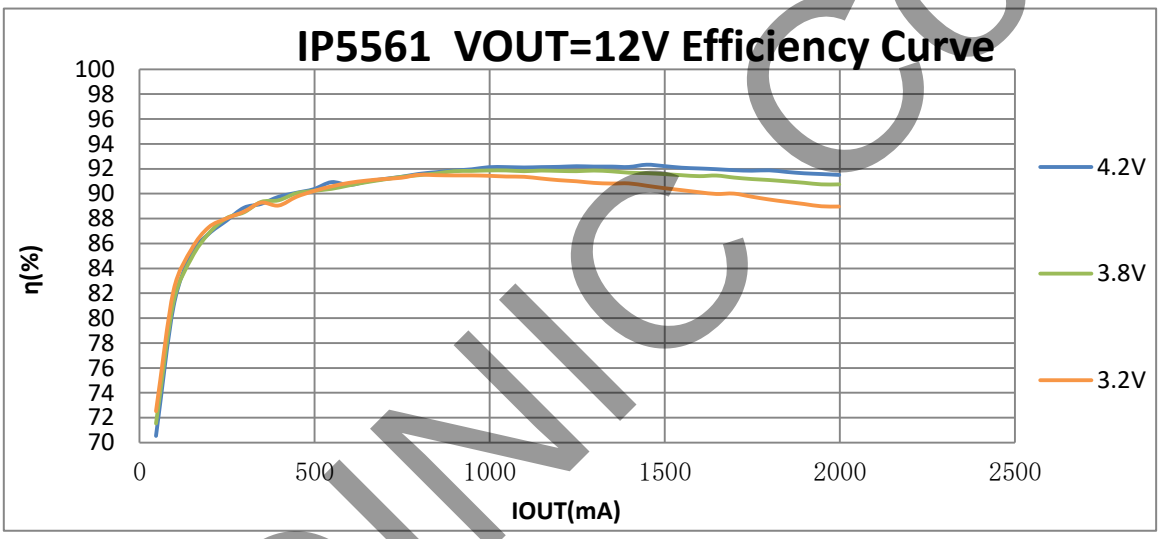



Figure 8 IP5561 VOUT=12V Efficiency Curve

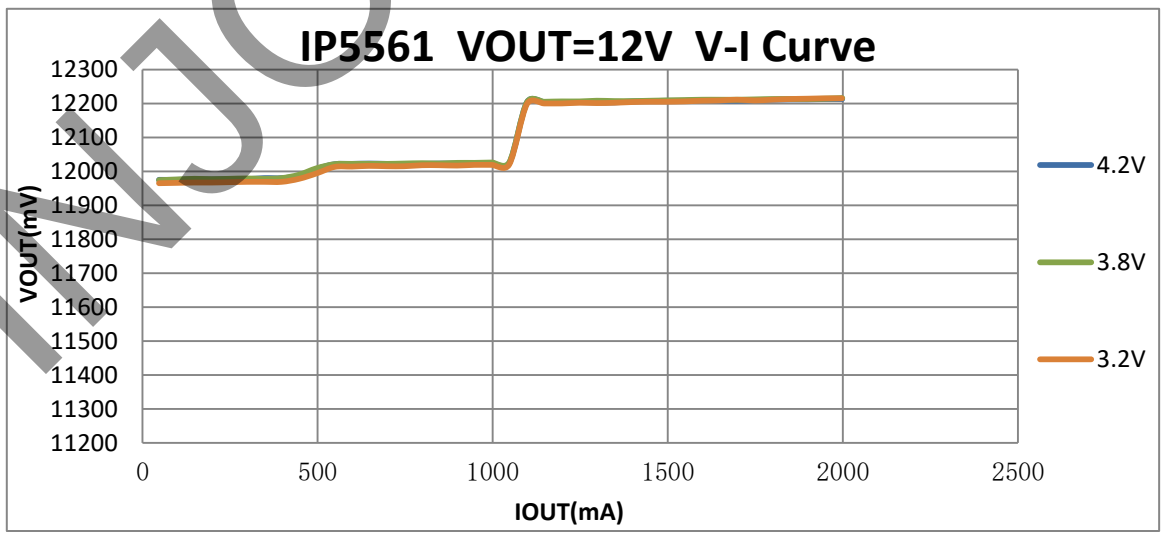



Figure 9 IP5561 VOUT=12V V-I Curve

## 12.4. USB C

IP5561 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, IP5561 will supply power for the opposite device.

When worked as DFP, the output current can be set as 3A; when worked as UFP, the current capability from the opposite device can be detected.

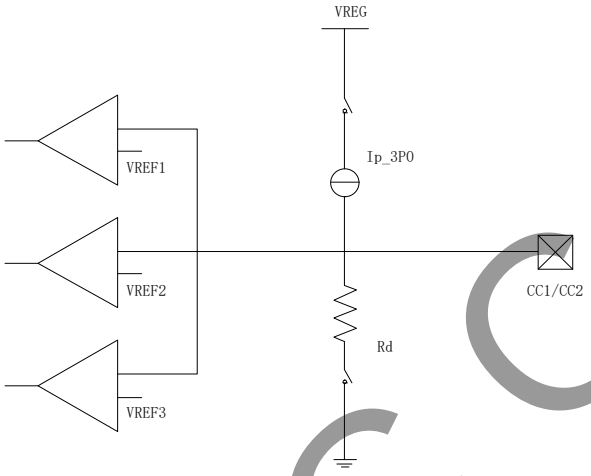



Figure 10 CC internal circuit

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**

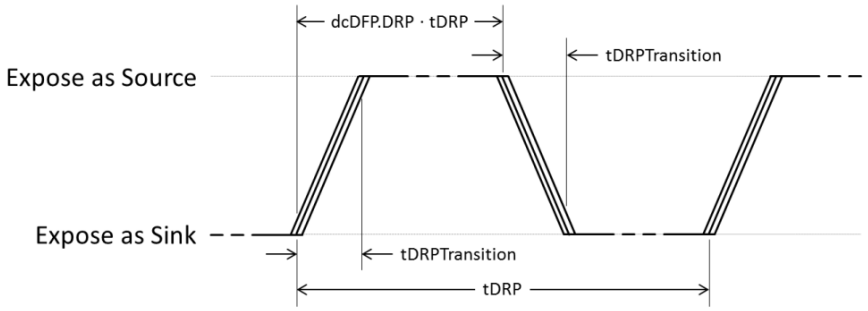



Figure 11 USB C detects cycle

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**

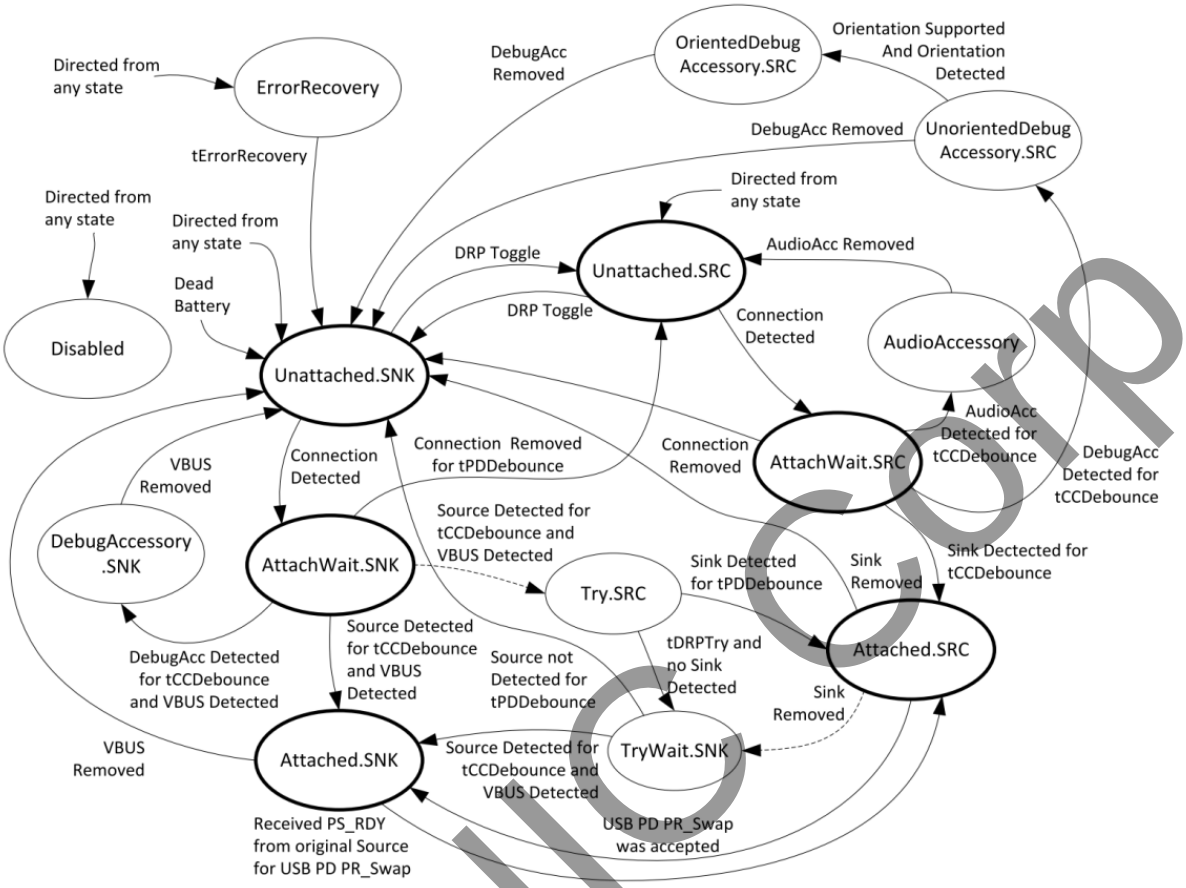



Figure 12 USB C detects state transition

## 12.5. USB C PD

IP5561 integrated USB C Power Delivery PD2.0/PD3.0 / PPS 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@3A、 9V@2.22A、12V @1.67A、PPS 3.3~11V@2A output voltage adjustable with 20mV / step. Support up to 20W power level.

## 12.6. Fast Charge Protocol

IP5561 support multi fast charge protocols: PD2.0 / PD3.0 / PPS、QC2.0 / QC3.0、FCP、AFC、SCP、Apple、Samsung.

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

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

If the power bank is to charge for the phone, when IP5561 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、



SCP、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 0.325V ~ 2V for 1.25s, fast charge will be initially determined, then the short status between DP and DM will be disconnected, and DM pull-down 20kΩ 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 200mV / step according to QC3.0 request under the continues mode.

Chart 6 Fast charging protocol supported by each port of IP5561

| protocols | VOUT output | VBUS output | VBUS input |
|---|---|---|---|
| QC2.0 | √ | √ | - |
| QC3.0 | √ | √ | - |
| AFC | √ | √ | √ |
| FCP | √ | √ | √ |
| SCP | √ | √ | - |
| PD2.0 | - | √ | √ |
| PD3.0 | - | √ | √ |
| PPS | - | √ | - |

Supported : √

Not Supported : -

## 12.7. Charge and Discharge Path Management

**Standby:**

If VBUS is attached, IP5561 will start the charging process directly.

If USB C UFP device is attached on VBUS or sink device is attached on VOUT port, IP5561 will start discharge function automatically.

If key is pressed, the VOUT and VBUS 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 60mA, it will automatically close after a period of time.

Any port of VOUT and VBUS 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 60mA for about 32S, the output port and discharge function will be closed and the standby mode will be entered.

When the wireless charge TX, VOUT, VBUS three outputs have any two or more outputs at the same time, output voltage is only 5V.

When only one port of wireless charging TX, VOUT, and VBUS is opened, the fast charging function is enabled.

When only the wireless charging TX charges the device and VOUT and VBUS are turned off, the wireless charging TX can transmit 10W/15W power.

**Charging:**

VBUS port can be charged by inserting the power supply.

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.

When only VBUS and wireless charging TX are working, and the VBUS applies for high voltage, the wireless charging TX can transmit 15W of power.

**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 the process of charging and discharging, if the charging power is unplugged, IP5561 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.

## 12.8. Automatic detection of mobile phone

**Auto detection on sink device / phone attachment:**

IP5561 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:**

IP5561 measures the output current of each port through the on-chip ADC. When the output current of a single port is less than about 60mA and lasts for about 16s, the output port will be closed. When the total current is less than about 60mA for about 32s, it is considered that all output cell phones are full or unplugged, and the boost output will be automatically turned off.

## 12.9. KEY / nixie tube selection

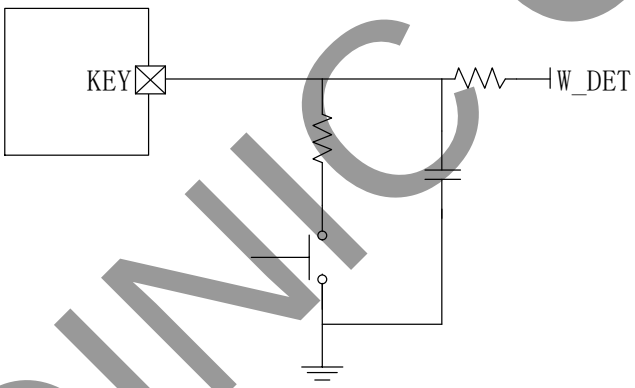



Figure 13 KEY circuit

Key circuit is illustrated in Figure 13, which can recognize short press or long press operation.

- Short press : pressed time in range of 60ms~2s：turn on the battery level display LED and boost output.
- No response on press time less than 30ms.
- Two short press in 1s: turn off boost output, battery level display LED.

## 12.10. Fast Charge state indication

LED4 of IP5561_LL 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.

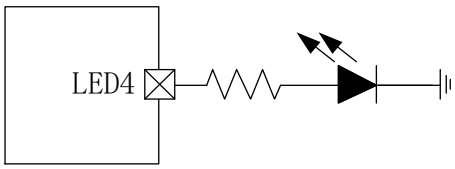



Figure 14 fast charge state indication

## 12.11. Coulombmeter and battery level display

IP5561 has built-in coulombmeter function, which can realize accurate calculation of the remaining battery capacity.

IP5561 supports 4 LED, 2 LED and 1 LED mode automatic selection.

IP5561 supports 88 / 188 nixie tube to display the remaining battery capacity .

### 12.11.1. Battery level display for LED mode

IP5561 4LED、2LED and 1LED battery level display solution, the connection method is as follows.

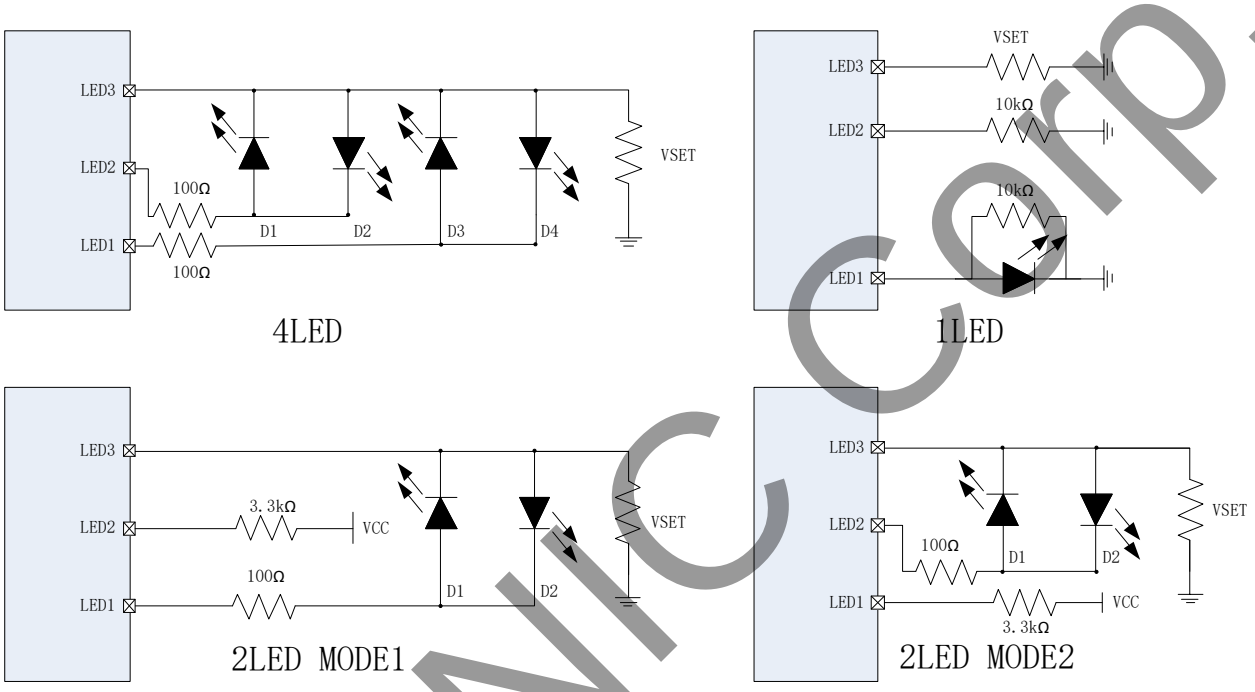



Figure 15 4LED , 2LED, 1LED circuits

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 | 0.6Hz Flash |
| 50%≤C<75% | ON | ON | 0.6Hz Flash | OFF |
| 25%≤C<50% | ON | 0.6Hz Flash | OFF | OFF |
| C<25% | 0.6Hz Flash | OFF | OFF | OFF |

Chart 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% | 1.2Hz Flash | OFF | OFF | OFF |
| C=0% | OFF | OFF | OFF | OFF |

Chart 9 2 LED display mode 1 is bi-color LED During charging

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

Chart 10 2 LED display mode 1 is bi-color LED During discharging

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

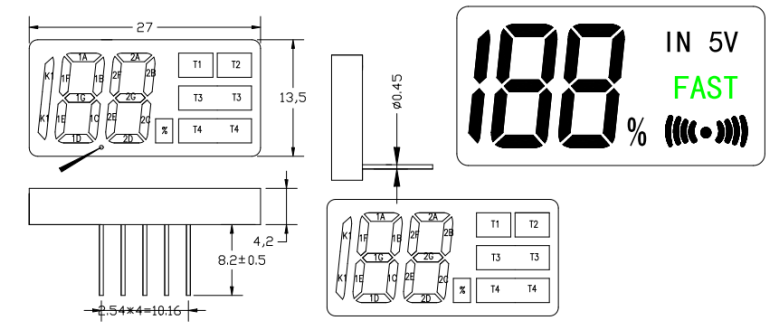
2 LED mode 2 display:
During charging: D1 LED flash on cycle of 1.6s (0.8s on and 0.8s off), when fully charged, constantly on;
During discharging: D2 LED is constantly on, when voltage lower than 3.2V, flash on cycle of 0.8s (0.4s on and 0.4s off), when voltage is lower than 3.0V, system is power down.
1 LED mode display:
During charging: LED flash on cycle of 1.6s (0.8s on and 0.8s off), when fully charged, constantly on;
During discharging: LED is constantly on, when voltage lower than 3.2V, flash on cycle of 0.8s (0.4s on and 0.4s off), when voltage is lower than 3.0V, system is power down.

### 12.11.2. 188 nixie tube display mode

Chart 11 The 188 nixie tube model IP5561 supported as below

| state | | display |
|---|---|---|
| During charging | Not fully charged | 0 - 99% 0.5HZ Flash |
| | Fullly charged | constantly on 100% |
| During discharging | Battery capacity>5% | 5% -100% constantly on |
| | Battery capacity <5% | 0 - 5% 1.0Hz Flash |
| | Wireless charging with load | wireless charging icon is on |
| | Wireless charging light load | wireless charger icon is off |
| | Wireless charging abnormal | wireless charger icon flash |

5pin 188 nixie tube:




4. 电路图（Circuit Diagram）：

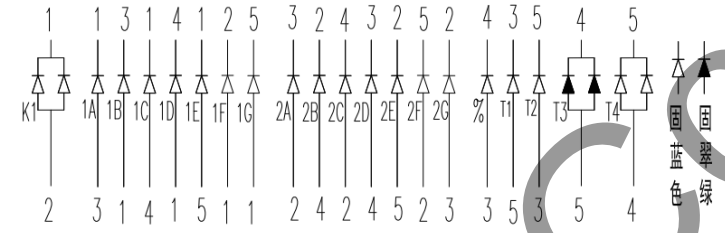



Figure 16 5pin 188 nixie tube circuit

Chart 12 IP5561 Light Drives Drive Pin and Digital Tube Pin Map Relationship

| | IP5561 display driver pin | nixie tube pin | note |
|---|---|---|---|
| The sequence mapping relationship between IP5561 display driver pin and nixie tube pin | LED1(2 pin) | 1 pin | |
| | LED2(3 pin) | 2 pin | |
| | LED3(4 pin) | 3 pin | |
| | LED4(11 pin) | 4 pin | |
| | LED5(10 pin) | 5 pin | |

### 12.11.3. Coulombmeter

IP5561 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.

IP5561 external pin sets the initial battery capacity formula: battery capacity = $R_{FCAP}$ * 0.448 (mAH). Up to 60000mah.

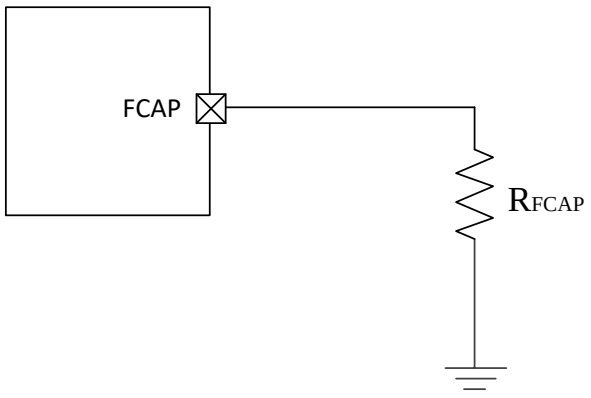



Figure 17 Battery capacity configuration circuit

Chart 13 Typical battery capacity config table

| $R_{FCAP}$ | battery initial capacity (mAh)=$R_{FCAP}$*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 |

## 12.12. VSET(Battery voltage selection)

IP5561_LL 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 14 Battery voltage selection config table

| $R_{LED3}$ | Battery full voltage selection |
|---|---|
| NC | 4.2V |
| 62kΩ | 4.3V |
| 33kΩ | 4.35V |
| 10kΩ | 4.4V |

## 12.13. NTC function

IP5561 integrates TWO NTC function, which can detect battery temperature, NTC1 is used to detect the battery temperature, and NTC2 is used to detect the wireless charging coil temperature. When IP5561 is working, NTC1 pin output 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.

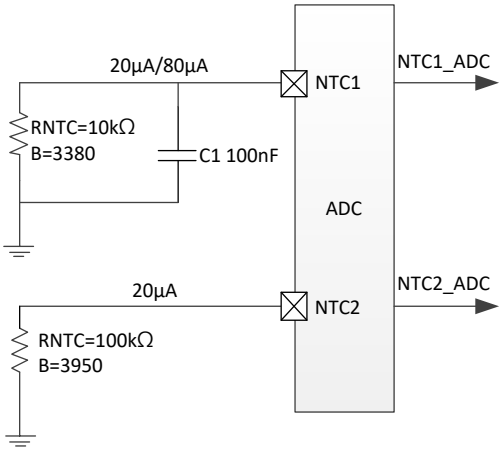



Figure 18 NTC1 circuit

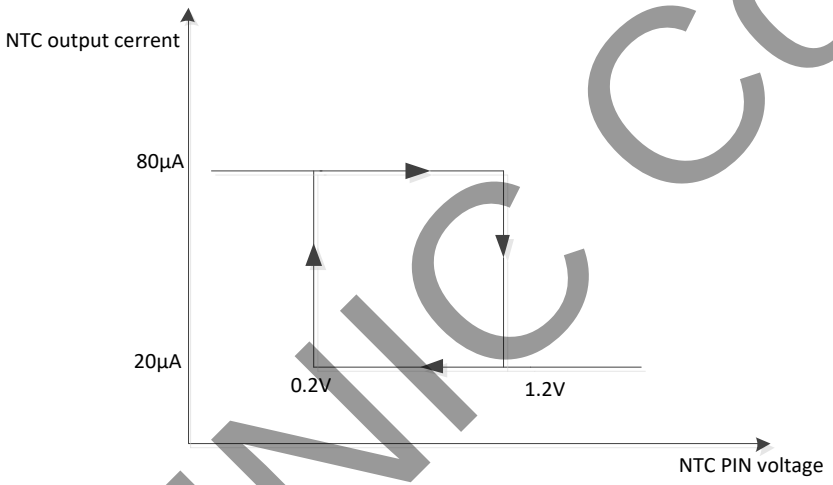



Figure 19 Relationship between NTC1 voltage and output current

In order to distinguish the temperature between high temperature and low temperature, NTC1 emits 80μA current at high temperature and 20μA current at low temperature.

When the NTC1 discharge current is 80μA, if the NTC1 voltage is higher than 1200mV, the current becomes 20μA;

When the NTC1 discharge current is 20μA, if the NTC1 voltage is lower than 200mV, the current changes to 80μA.

In the state of charge:

When the NTC1 voltage is lower than 0.39V, it means the battery temperature is higher than 45℃, the charging is stopped.

When the NTC1 voltage is higher than 0.54V, it means the battery temperature is lower than 0℃, the charging is stopped.

In the state of discharge:

When the NTC1 voltage is lower than 0.24V, it means the battery temperature is higher than 60℃,



the discharging is stopped.

When the NTC1 voltage is higher than 1.38V, it means the battery temperature is lower than -20℃, the discharging is stopped.

If NTC1 is not required in the application, 10kΩ resistance shall be connected to the ground at NTC1 pin, and floating or direct grounding is not allowed.

NTC2 is used to detect the temperature of the wireless charging coil. The output current of the NTC2 pin is 20μA. When the voltage detected by the NTC2 pin is lower than 0.29V, the coil temperature exceeds 75 ℃, and the wireless charging and discharging will be turned off. When the NTC2 voltage is higher than 0.7V (coil temperature is lower than 50 ° C), wireless charge and discharge will be resumed.

## 12.14. Wireless charging

### 12.14.1. H Bridge Drive

The IP5561 has two built-in symmetrical half-bridge driver modules and an external N+PMOS H-bridge. The dead time and drive strength of the driver modules can be software configured to different gears. During EMI EMC testing, the EMI margin can be improved by configuring a lower drive capability, thus saving external RC devices.

The IP5561 uses 20mΩ sampling resistor for low-side sampling of the H-bridge current, and the RC filter device for the sampled signal should be placed close to the IC to avoid noise interference.

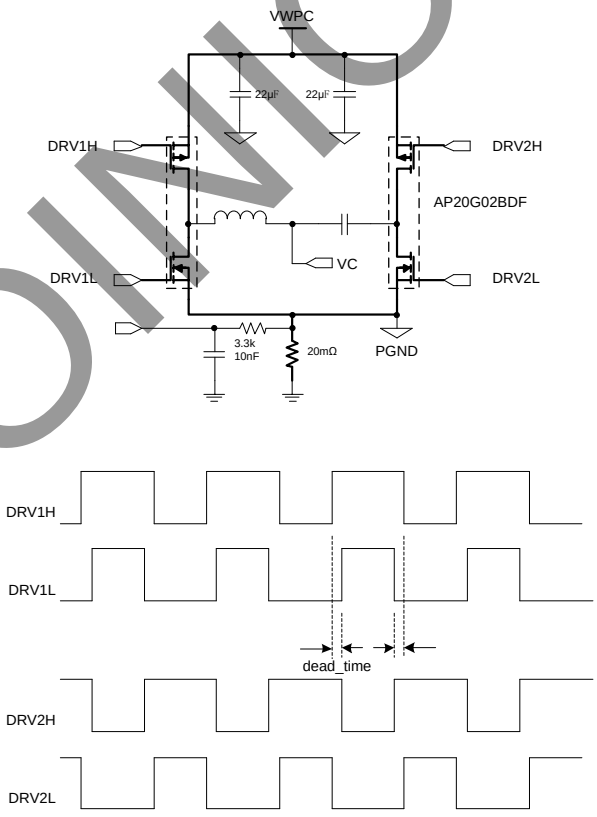



Figure 20 Wireless charging H Bridge

### 12.14.2. ASK communication demodulation/FSK modulation

The IP5561 has a built-in ASK demodulation module. For the ASK modulated signal from the

receiving device, the IP5561 collects the coil voltage and current for ASK signal demodulation and decoding respectively. The system implements the QI wireless charging protocol based on the ASK decoded data.

IP5561 has built-in FSK modulation function, through FSK modulation, IP5561 can send information to the receiving device to realize PPDE, EPP, MPP and other protocols.

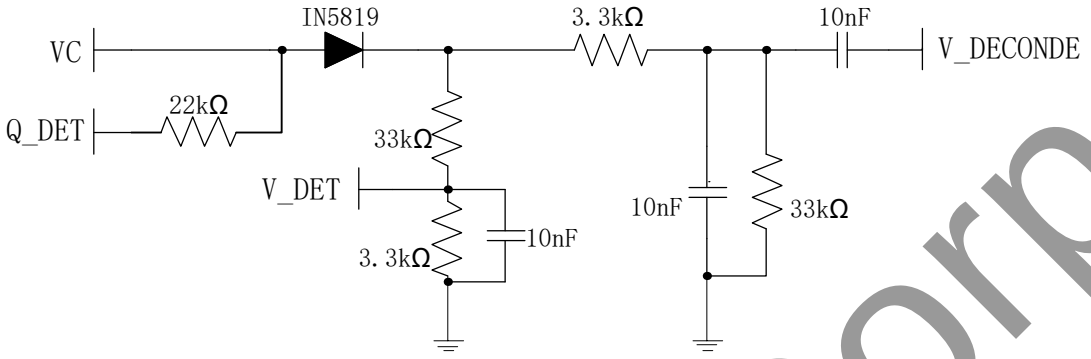



Figure 21 Wireless charging and demodulation circuit

### 12.14.3. Wireless Charging Indicators

The IP5561 supports NTC2 pin time-sharing multiplexing to achieve the LED indicator function, which indicates the wireless charging status by driving the NTC2 output. The corresponding relationship between the LED status and the wireless charging system status is as follows.

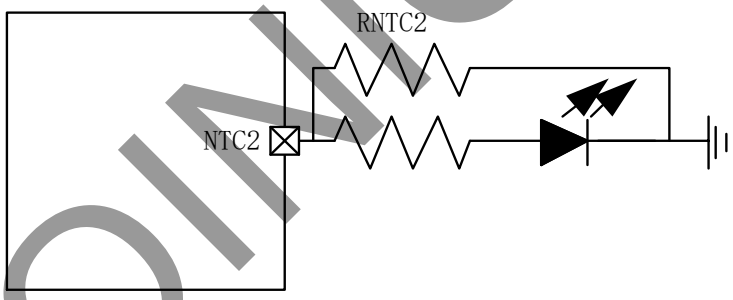



Figure 22 Wireless Charging Indicators

Chart 15 Wireless lamp display

| State | NTC2(33PIN) |
|---|---|
| Power on | Blink three times at 1.0HZ |
| Wireless charging abnormal | 1.0HZ Flash |
| Charge complete | OFF |
| Charging | 0.5HZ Flash |
| standby | ON |

### 12.14.4. Wireless Charging Automatic Wake Up

IP5561 wireless charging supports automatic detection of mobile phone, mobile phone is placed on the coil immediately wake up from the standby state, open the output to charge the phone, no button



operation, support no button solution.

### 12.14.5. Wireless Charging Sampling Battery Voltage

IP5561 supports wireless charging sampling battery voltage, and the remaining battery power can be displayed through the double window when charging the mobile phone.

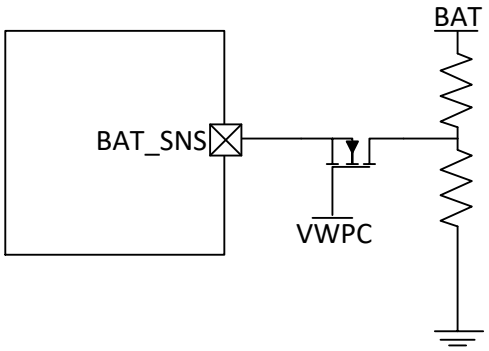



Figure 23 Wireless rechargeable battery voltage sampling circuit

### 12.14.6. FOD threshold setting

IP5561_LL_Pxxx series supports the FOD threshold selection through the NTC2 pin and the configuration of different static and dynamic FOD parameters. This series does not support coil temperature detection.Chart 16 shows the resistance $R_{FOD\_SEL}$ and FOD thresholds.

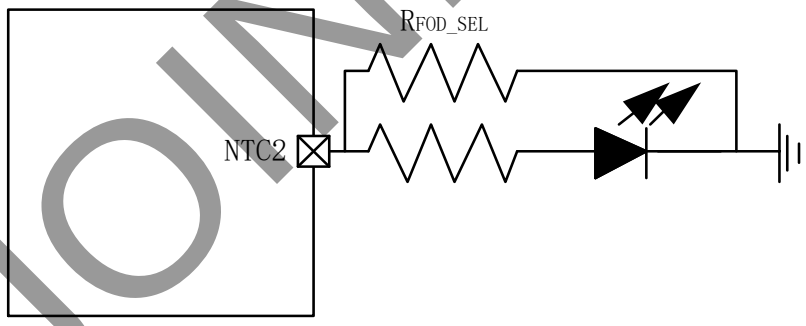



Figure 24 FOD threshold setting

Chart 16 FOD threshold

| $R_{FOD\_SEL}$ | Static FOD threshold | Dynamic FOD threshold（mW） |
|---|---|---|
| 0Ω-20kΩ | R*8+100 | -500 |
| 25kΩ-45kΩ | (R-25)*8+100 | 0 |
| 50kΩ-70kΩ | (R-50)*8+100 | 500 |

Non-magnetic default resistance 25 kΩ, magnetic default resistance 39 kΩ.

## 12.15. VCC

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

## 12.16. I2C

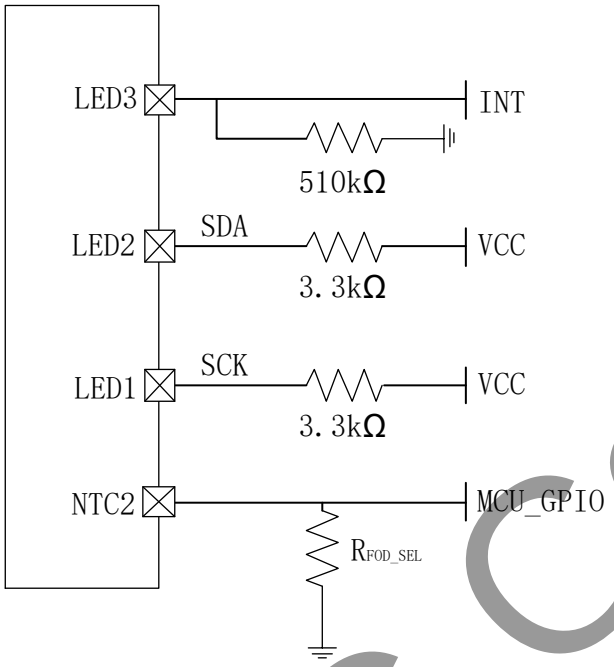



Figure 25 I2C

IP5561_LL_PXXX series supports I2C connection. According to the corresponding connection mode, IC will automatically enter ot close I2C 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. IP5561_LL_PXXX series supports MCU to read mobile power related information through I2C, Indicate the wireless charging status through the high and low level status of NTC2, does not support NTC2 Coil temperature detection function, detailed information can refer to IP5561(with reg) data.

# 13. PCB Layout

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

## 13.1. Location of VOUT / VBUS / VWPC capacitor

IP5561 integrates USB output power path. The 2.2μF capacitor of VOUT / VBUS / VWPC 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.

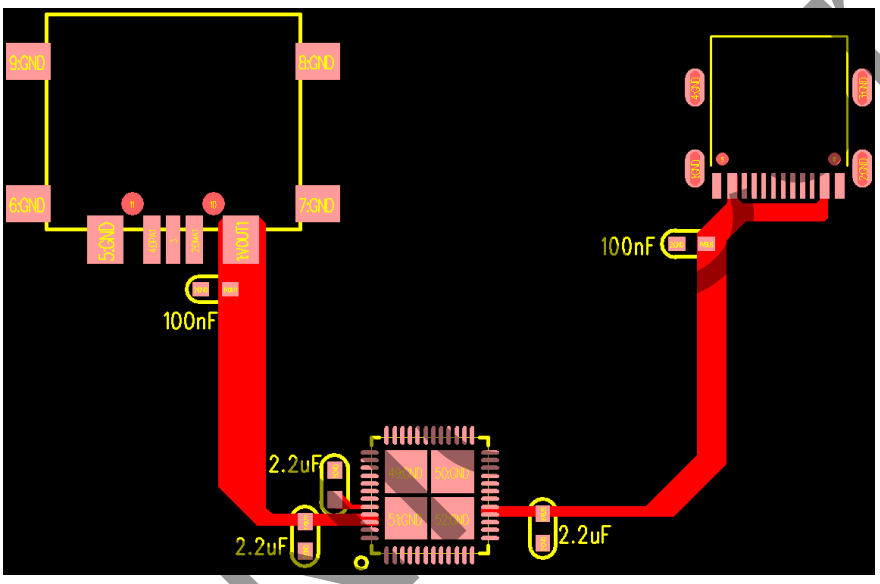



Figure 26 Location of VOUT1 / VOUT2 / VBUS capacitor

## 13.2. 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.

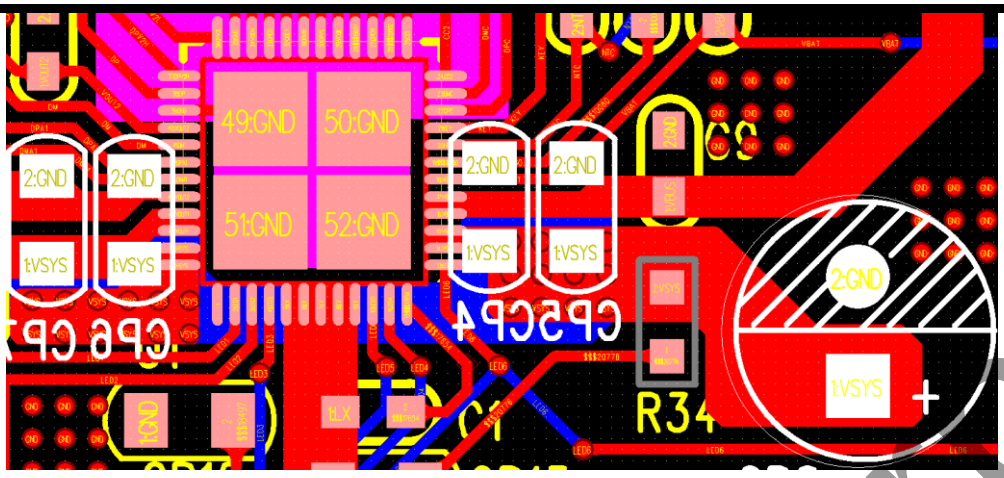



Figure 27 Location of VSYS capacitor

## 13.3. Location of BAT/VCC/VDD/NTC capacitor

The filter capacitors of bat pin and BAT/VCC/VDD/NTC 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.

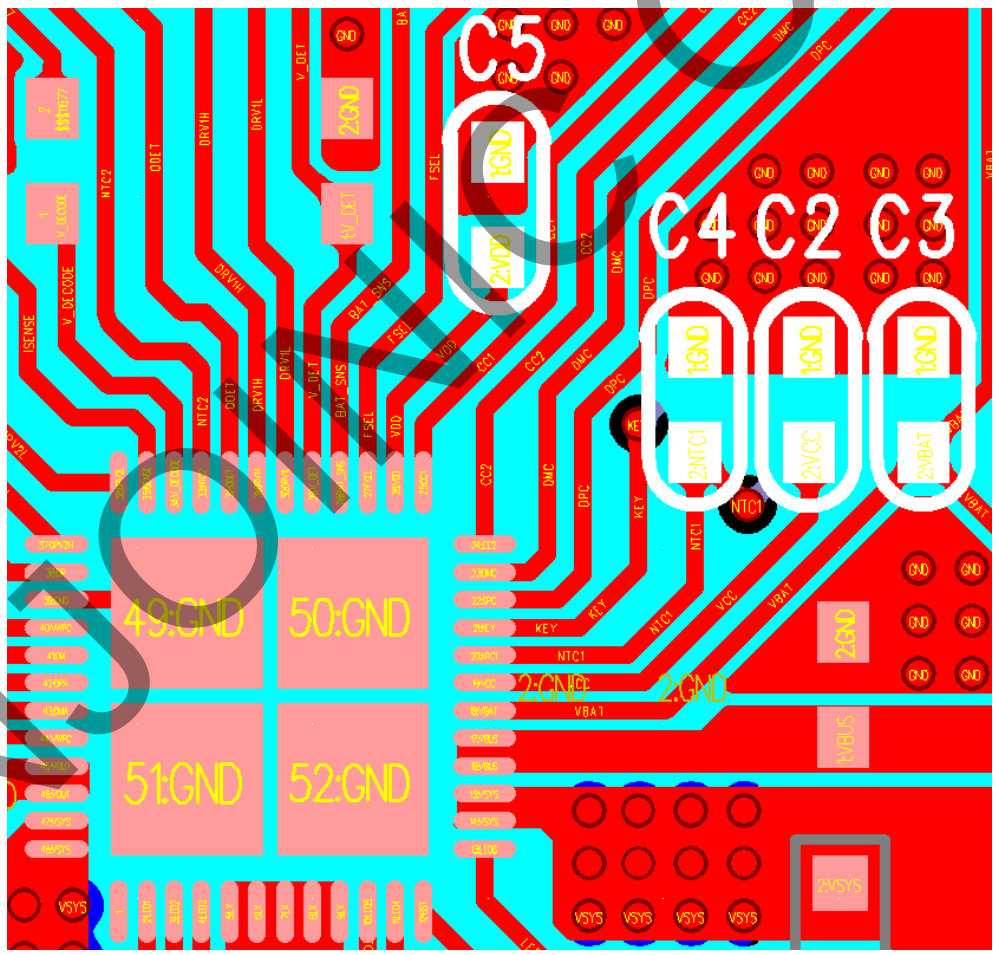



Figure 28 Location of BAT/VCC capacitor

## 13.4. Wireless charging Sampling resistance

IP5561 samples the H-bridge current through the 20mΩ sampling resistance. The ground of the 20mΩ sampling resistance needs to be separately laid with copper to the chip EPAD. The RC filtering circuit of the sampled signal should be placed close to the chip pin, otherwise the wireless charging circuit is prone to noise interference and will not work normally.


Figure 29 Wireless charging sampling resistance wiring

# 14. Typical Application Diagram

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

## 14.1. Power bank+TX+LED application

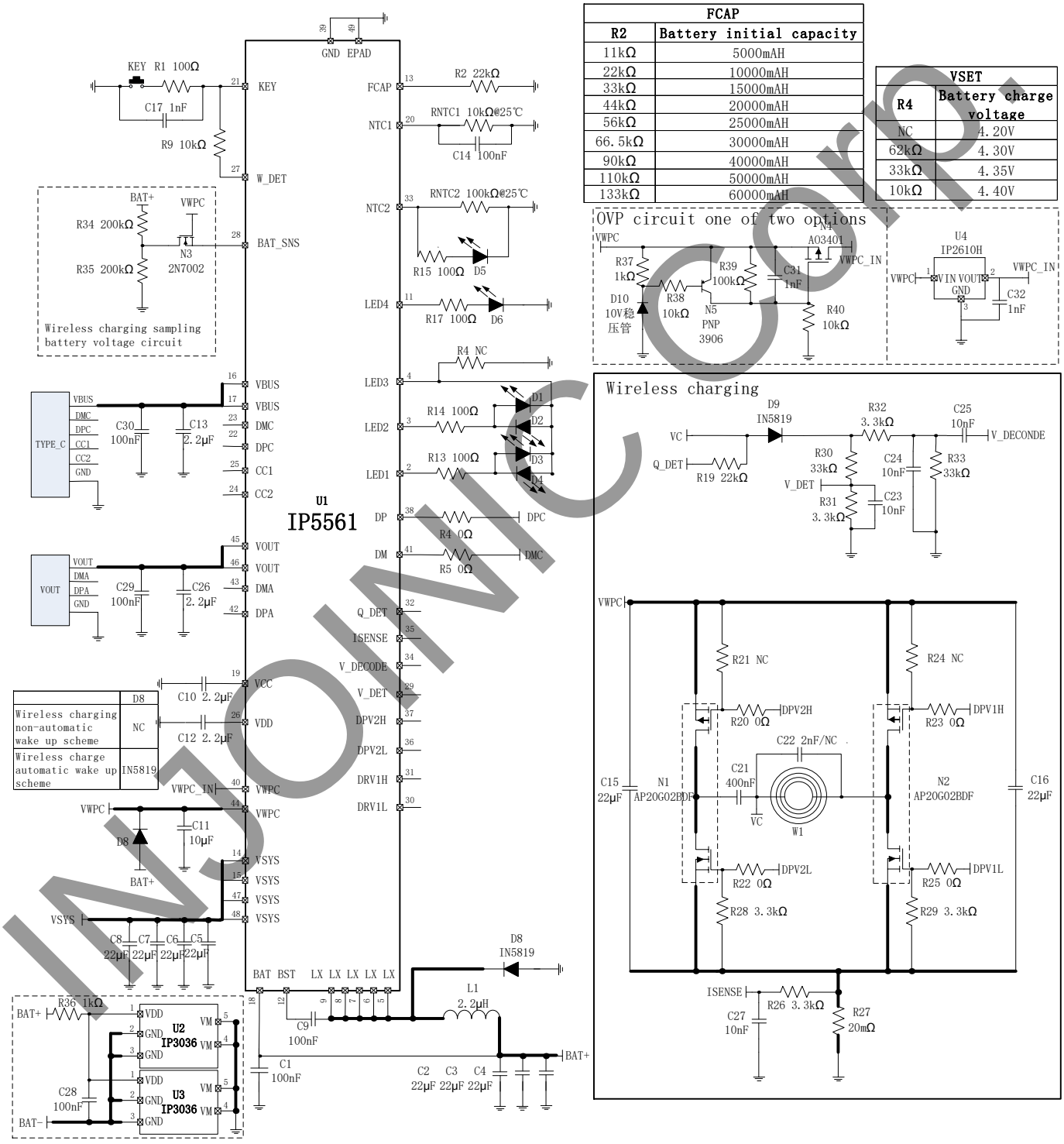



Figure 30 IP5561 LED application circuit

BOM 表

| No. | Part Name | Type | Location | Num | Note |
|---|---|---|---|---|---|
| 1 | IC | QFN48 IP5561 | U1 | 1 | |
| 2 | SMT capacitor | 0603 100nF 10% 25V | C1 C9 C14 C29 C30 | 5 | |
| 3 | SMT capacitor | 0805 22μF 10% 16V | C2 C3 C4 | 3 | |
| 4 | SMT capacitor | 0805 22μF 10% 25V | C5 C6 C7 C8 | 4 | |
| 5 | SMT capacitor | 0603 2.2μF 10% 25V | C10 C12 C13 C26 | 4 | |
| 6 | SMT capacitor | 0603 1nF 10% 25V | C17 | 1 | |
| 7 | SMT capacitor | 0603 10μF 10% 25V | C11 | 1 | |
| 8 | SMT capacitor | CAP-5-5 100μF | CP1 | 1 | |
| 9 | SMT Schottky | IN5819 | D8 D9 | 2 | |
| 10 | KEY | SMT 3*6 | KEY | 1 | |
| 11 | Inductor | 2.2μH 10*10 | L1 | 1 | |
| 12 | Output USB connector | AF10 8 USB | VOUT | 1 | |
| 13 | USB C connector | USB C connector | TYPE_C | 1 | |
| 14 | SMT resistor | 0603 100Ω 1% | R1 | 1 | |
| 15 | SMT resistor | 0603 22kΩ 1% | R2 | 1 | |
| 16 | SMT resistor | 0603 10kΩ 1% | R9 | 1 | |
| 17 | SMT resistor | 0603 0Ω 1% | R4 R5 R17 | 3 | |
| 18 | SMT resistor | 0603 100Ω 1% | R13 R14 R15 R17 | 4 | |
| 19 | SMT LED | 0603 | D1 D2 D3 D4 D5 D6 | 6 | |
| 20 | NTC thermal resistor | 10 kΩ@25℃ B=3380 | RNTC1 | 1 | |
| 21 | NTC thermal resistor | 100 kΩ@25℃ B=3950 | RNTC2 | 1 | |
| 22 | SMT capacitor | 0805 22μF 10% 25V | C15 C16 | 2 | Wireless charging circuit BOM |
| 23 | CBB resonant capacitor | 400nF 100V | C21 | 1 | |
| 24 | SMT capacitor | 0603 2nF/NC | C22 | 1 | |
| 25 | SMT capacitor | 0603 10nF 10% 50V | C23 | 1 | |
| 26 | SMT capacitor | 0603 10nF 10% 50V | C25 | 1 | |
| 27 | SMT capacitor | 0603 10nF 10% 50V | C24 C27 | 1 | |
| 28 | SMT resistor | 0603 0Ω 1% | R20 R22 R23 R25 | 4 | |
| 29 | SMT resistor | 0603 3.3kΩ 1% | R26 R31 R32 | 3 | |
| 30 | SMT resistor | 0603 33kΩ 1% | R30 R33 | 2 | |
| 31 | SMT resistor | 1206 20mΩ 1% | R27 | 1 | |
| 32 | SMT resistor | 0603 22kΩ 1% | R19 | 1 | |
| 33 | SMT resistor | 0603 200kΩ 1% | R34 R35 | 2 | |
| 34 | SMT MOS | PDFN3*3-8L AP20G02BDF | N1 N2 | 2 | |
| 35 | SMT NMOS | SOT-23 2N7002 | N3 | 1 | |
| 36 | SMT resistor | 0603 3.3kΩ 1% | R28 R29 | 2 | |
| 37 | Coil | A11 | W1 | 1 | |



| | | | | | |
|---|---|---|---|---|---|
| 38 | IC | CPC8-5 IP3036 | U2 U3 | 2 | Lithium protection circuit BOM |
| 39 | SMT capacitor | 0603 100nF 10% 16V | C28 | 1 | |
| 40 | SMT resistor | 0603 1kΩ 1% | R36 | 1 | |
| 41 | IC | IP2610H | U4 | 1 | |
| 42 | SMT capacitor | 0603 1nF 10% 25V | C31 C32 | 2 | |
| 43 | SMT resistor | 0603 1kΩ 1% | R37 | 1 | |
| 44 | SMT resistor | 0603 10kΩ 1% | R38 R40 | 2 | |
| 45 | SMT resistor | 0603 100kΩ 1% | R39 | 1 | |
| 46 | Voltage regulator tube | 10V | D10 | 1 | |
| 47 | SMT NMOS | SOT-23 AO3401 | N4 | 1 | |
| 48 | SMT PNP | 3906 | N5 | 1 | |

## 14.2. Power bank+TX+188 application

| FCAP | |
|---|---|
| R2 | Battery initial capacity |
| 11kΩ | 5000mAH |
| 22kΩ | 10000mAH |
| 33kΩ | 15000mAH |
| 44kΩ | 20000mAH |
| 56kΩ | 25000mAH |
| 66.5kΩ | 30000mAH |
| 90kΩ | 40000mAH |
| 110kΩ | 50000mAH |
| 133kΩ | 60000mAH |

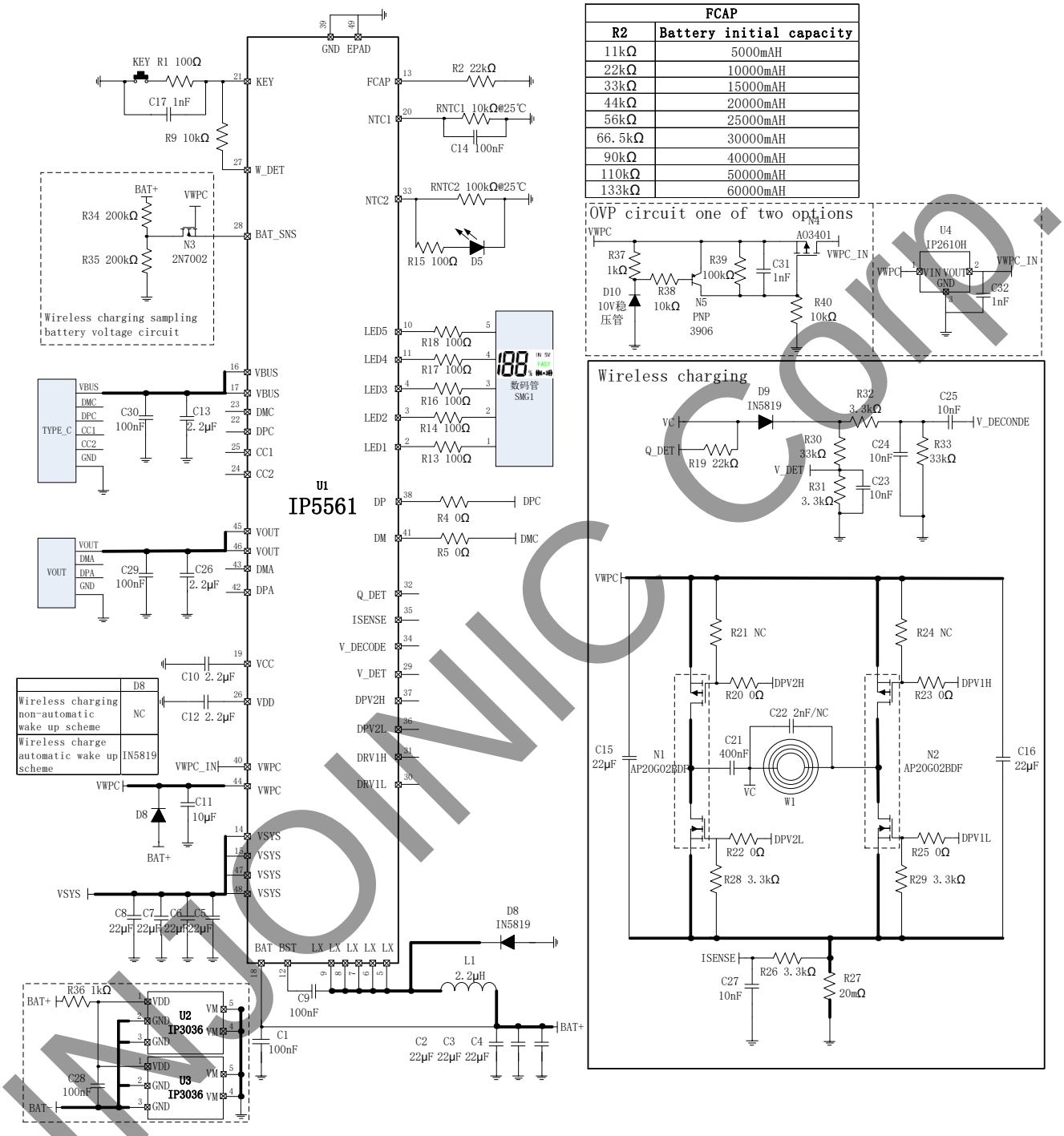



Figure 31 IP5561_188 Nixie tube application circuit

BOM 表

| No. | Part Name | Type | Location | Num | Note |
|---|---|---|---|---|---|
| 1 | IC | QFN48 IP5561 | U1 | 1 | |
| 2 | SMT capacitor | 0603 100nF 10% 25V | C1 C9 C14 C29 C30 | 5 | |
| 3 | SMT capacitor | 0805 22μF 10% 16V | C2 C3 C4 | 3 | |
| 4 | SMT capacitor | 0805 22μF 10% 25V | C5 C6 C7 C8 | 4 | |
| 5 | SMT capacitor | 0603 2.2μF 10% 25V | C10 C12 C13 C26 | 4 | |
| 6 | SMT capacitor | 0603 1nF 10% 25V | C17 | 1 | |
| 7 | SMT capacitor | 0603 10μF 10% 25V | C11 | 1 | |
| 8 | SMT capacitor | CAP-5-5 100μF | CP1 | 1 | |
| 9 | SMT Schottky | IN5819 | D8 D9 | 2 | |
| 10 | KEY | SMT 3*6 | KEY | 1 | |
| 11 | Inductor | 2.2μH 10*10 | L1 | 1 | |
| 12 | output USB | AF10 8 USB | VOUT | 1 | |
| 13 | USB C CONNECTOR | USB C connector | TYPE-C | 1 | |
| 14 | SMT resistor | 0603 100Ω 1% | R1 | 1 | |
| 15 | SMT resistor | 0603 22kΩ 1% | R2 | 1 | |
| 16 | SMT resistor | 0603 10kΩ 1% | R9 | 1 | |
| 17 | SMT resistor | 0603 0Ω 1% | R4 R5 | 2 | |
| 18 | SMT resistor | 0603 100Ω 1% | R13 R14 R15 R16 R17 R18 | 6 | |
| 19 | SMT LED | 0603 | D5 | 1 | |
| 20 | NTC thermal resistor | 10 kΩ@25℃ B=3380 | RNTC1 | 1 | |
| 21 | NTC thermal resistor | 100 kΩ@25℃ B=3950 | RNTC2 | 1 | |
| 22 | SMT diode | YFTD2715AWPG-5D | SMG1 | 1 | |
| 23 | SMT capacitor | 0805 22μF 10% 25V | C15 C16 | 2 | Wireless charging circuit BOM |
| 24 | CBB resonant capacitor | 400nF 100V | C21 | 1 | |
| 25 | SMT capacitor | 0603 2nF/NC | C22 | 1 | |
| 26 | SMT capacitor | 0603 10nF 10% 50V | C23 | 1 | |
| 27 | SMT capacitor | 0603 10nF 10% 50V | C25 | 1 | |
| 28 | SMT capacitor | 0603 10nF 10% 50V | C24 C27 | 1 | |
| 29 | SMT resistor | 0603 0Ω 1% | R20 R22 R23 R25 | 4 | |
| 30 | SMT resistor | 0603 3.3kΩ | R26 R31 R32 | 3 | |
| 31 | SMT resistor | 0603 33kΩ | R30 R33 | 2 | |
| 32 | SMT resistor | 1206 20mΩ 1% | R27 | 1 | |
| 33 | SMT resistor | 0603 22kΩ 1% | R19 | 1 | |
| 34 | SMT resistor | 0603 200kΩ 1% | R34 R35 | 2 | |
| 35 | SMT MOS | PDFN3*3-8L AP20G02BDF | N1 N2 | 2 | |
| 36 | SMT resistor | 0603 3.3kΩ 1% | R28 R29 | 2 | |



| | | | | | |
|---|---|---|---|---|---|
| 37 | SMT NMOS | SOT-23 2N7002 | N3 | 1 | |
| 38 | Coil | A11 | W1 | 1 | |
| 39 | IC | CPC8-5 IP3036 | U2 U3 | 2 | Lithium protection circuit BOM |
| 40 | SMT capacitor | 0603 100nF 10% 16V | C28 | 1 | |
| 41 | SMT resistor | 0603 1kΩ 1% | R36 | 1 | |
| 42 | IC | IP2610H | U4 | 1 | |
| 43 | SMT capacitor | 0603 1nF 10% 25V | C31 C32 | 2 | |
| 44 | SMT resistor | 0603 1kΩ 1% | R37 | 1 | |
| 45 | SMT resistor | 0603 10kΩ 1% | R38 R40 | 2 | |
| 46 | SMT resistor | 0603 100kΩ 1% | R39 | 1 | |
| 47 | Voltage regulator tube | 10V | D10 | 1 | |
| 48 | NMOS | SOT-23 AO3401 | N4 | 1 | |
| 49 | PNP | 3906 | N5 | 1 | |

Recommended inductance model

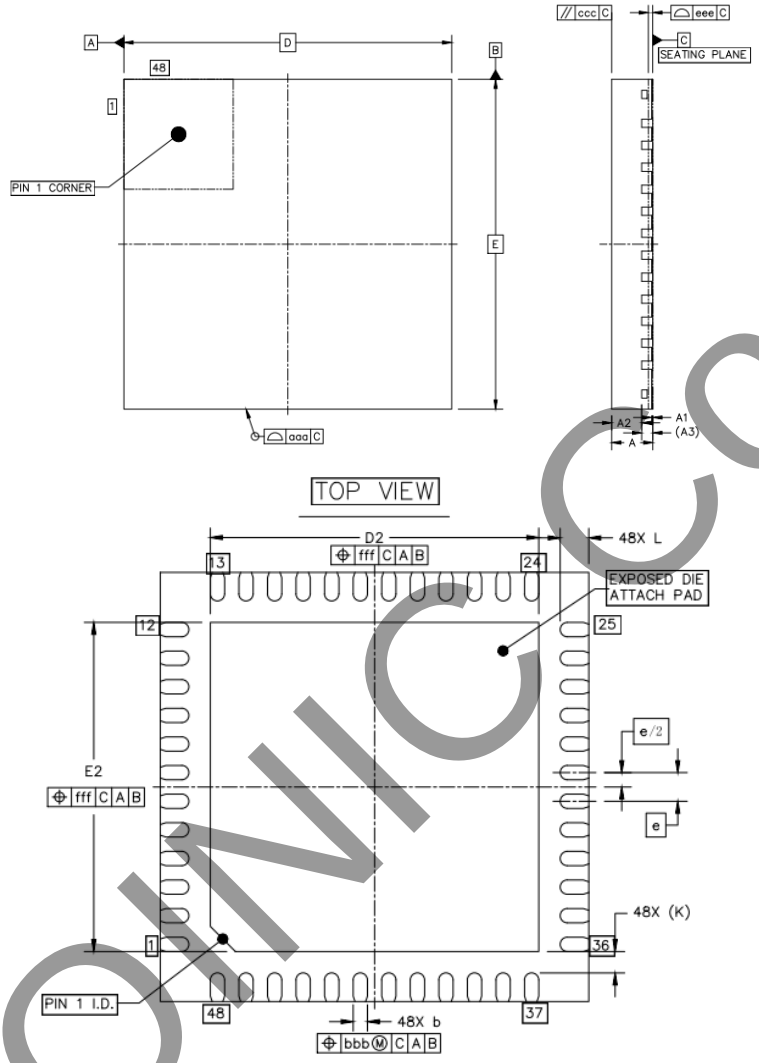
| DARFON PIN | Thickness (mm) | Inductance (μH) | Tolerance | DC Resistance (mΩ) | | Heat Rating Current DC Amp. | Saturation Current DC Amps. | Measuring Condition |
|---|---|---|---|---|---|---|---|---|
| | | | | Typ. | Max. | Idc(A)Max. | Isat(A)Max. | |
| SPM70702R2MESQ | 5 | 2.2 | ±20% | 9 | 10.2 | 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 | |



# 15. Package

## 15.1. Chip package




| | | 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 | 4.5 | 4.6 | 4.7 |
| | Y | E2 | 4.5 | 4.6 | 4.7 |
| LEAD LENGTH | | L | 0.3 | 0.4 | 0.5 |
| LEAD TIP TO EXPOSED PAD EDGE | | K | | 0.3 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. Silk Screen Description


说明：
1、 --Injoinic Logo
2、IP5561 --Part Number
3、XXXXXXXX --Manufacture lot number
4、 --Pin1 location

Figure 32 Silk Screen Description

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