one,IP5389Selection instructions

1,supportledlamp/188Digital TubepinSelected model

МодельIP5389	Selection reference	Number of functions
IP5389_BZ	1, mainly used for beltsledand digital tube 2 ,support A+A+C+B+Lightninginterface plan	1,support led and188 Automatic Identification 2 ,support 2-6S Cell string number selection 3 , support pin Select power, full voltage, NTCand other functions 4,support SCP Protocol input and output
IP5389_BZ_2H	1, mainly used for beltsledand digital tube 2 ,supportA+A+C+B+LightningInterface scheme 3, support "always on" mode, press and hold the button2s Turn on, keep discharging2hDo not shut down.	1,support led and188 Automatic Identification 2 ,support 2-6 SCell string number selection 3 ,supportpin Select power, full voltage, NTC and other functions 4,support SCP Protocol input and output
IP5389_BZ_AACC	1, mainly used for beltsledand digital tube 2, support A+A+(DRP)+ C(DRP) pair CInterface scheme	1,support led and 188 Automatic Identification 2 ,support 2-6S Cell string number selection 3 ,supportpinSelect power, full voltage, NTCand other functions 4,supportSCPProtocol input and output
IP5389_BZ_AACC_2H	1, mainly used for beltsledand digital tube 2 ,supportA+A+C+B+Lightninginterface plan 3, support "always on" mode, press and hold the button 2s open Turn on, keep discharging 2h Do not shut down.	1,support led and 188 Automatic Identification 2 ,support 2-6s Cell string number selection 3 ,support pin Select power, full voltage, NTC and other functions 4,support SCP Protocol input and output
IP5389_BZ_ABCCO	1, mainly used for belts led and digital tube 2 ,supportA+C(DFP)+B+ C(DRP) catch oral plan	1,supportledand188Automatic Identification 2 ,support2-6SCell string number selection 3 ,supportpinSelect power, full voltage, NTCand other functions 4,supportSCPProtocol input and output
IP5389_FPP_AACC	1, Support high-voltage fast charging, charge and discharge at the same time (C1 Quick mouth While charging the inputC2port fast charging output; C2 port fast charge input at the same time C1 port fast charging output; C1or C2 Port fast charge input at the same time Aport fast charging output) 2,supportC(DRP)+C(DRP)+A+A pairC(DRP)Interface scheme	1,support led and 188 Automatic Identification 2 , support 2-6 SCell string number selection 3, support pin Choose full voltage,NTCand other functions 4,support SCP Protocol input and output
IP5389_OCV_AACC	1. Mainly used with LED and digital tube 2. Supports A+A+(DRP)+C(DRP) double C interface solution 3. Support high-power lighting (requires external LED lights)	1,support led and188 Automatic Identification 2,support 2-6S Cell string number selection 3, supportpin Select power, full voltage, and other functions. Not supported yet NTC Function pin select.

	driver IC), and supports lighting current sampling	4,support SCP Protocol input and output

The protocols supported by each port of the above scheme are as follows:

Input and output port	Supported fast charging protocols
USBAport output	QC2.0, QC3.0, FCP, AFC, low pressure SCP, low pressure VOOC
MicroBmouth input	AFC, high pressure SCP, FCP
Type-Cmouth input	PD, AFC, high pressure SCP, FCP
Type-Cport output	PD, QC2.0, QC3.0, FCP, AFC, high pressure SCP, low pressure VOOC
Lightningmouth input	PD(Highest 12V)

Among the above solutions, only IP5389_BZ and IP5389_BZ_2H of C port output, A Port output additional support QC3 + protocol.

2, support I2C Controlled model

IP5389 model	Selection reference	Number of functions
IP5389_I2C_AACC	1. Mainly used for coordination MCU Use, can pass Pass I2C access internal information; 2. Support supportA+A+(DRP)+ C(DRP) pair C Interface scheme	1, support fuel gauge readability 2,support 2~6s Cell string number selection 3,accessible I2C Customize various functions, such as Input and output power,PDOCurrent envelope Interest and so on 4, only supports SCP Protocol output
IP5389_I2C_BC	1, mainly used to cooperate withMCUUse, can pass PassI2Caccess internal information; 2,support1indivualC(DRP)Two-way input and output out; 3,VINoral interfaceDCPower input supports solar input,DCDC adapter input, support MPPT, adaptive adapter output capability and other functions able	1, support fuel gauge readability 2,support 2~6s Cell string number selection accessible I2C Customize various functions, such as Input and output power,PDO Current envelope Interest and so on 3, only supports SCP Protocol output
IP5389_I2C_AACD	1, mainly used to cooperate with MCU Use via I2C access internal information; 2, supportA+A+ C (DRP) C Oral two-way transmission Input and output plan; 3,V IN oral interface DC Power input supports solar input, DC DC adapter input, support MPPT, adaptive adapter output capability and other able functions	1, support fuel gauge readability 2,support 2~6s The number of cell strings can be selected throughI2CCustomize various functions, such as input Input and output power,PDO Current packet information, etc. 3, only supports SCP Protocol output
IP5389_I2C_DC_IP65	1, mainly used to cooperate withMCUUse via I2Caccess internal information; 2, can be plugged in IP6538, IP6525S Waiting for the bus ChargeICTo achieve the effect of dual fast charging (only supports Use our car chargerIC, specific support is fast The charging protocol is determined by the car charger usedICDecide) 3,supportLightning+B+C(DRP)+2A or A+C(DFP) Interface scheme	1, support fuel gauge readability 2,support 2~6s The number of cell strings can be selected through I2C Customize various functions, such as input Input and output power,PDO Current packet information, etc. 3, only supports SCP Protocol output

The protocols supported by each port of the above scheme are as follows:

Input and output port	Supported fast charging protocols
USBAport output	QC2.0,QC3.0,FCP,AFC, low pressureSCP, low pressureVOOC
MicroBmouth input	AFC,FCP
Type-Cmouth input	PD,AFC,FCP
Type-Cport output	PD,QC2.0,QC3.0,FCP,AFC,high pressureSCP, low pressureVOOC
Lightningmouth input	PD(Highest12V)

3, can be addedDC-DCmodel

IP5389model	Selection reference	Number of functions
IP5389_DC_IP65	1, can be plugged in IP6538, IP6525S Waiting for car charging ICTo achieve the effect of double fast charging (only supports our company car chargerIC, the specific supported fast charging protocol is determined by the user car chargerICDecide) 2,supportLightning+B+C(DRP)+A+A orA+C(DFP) The interface solution supports "normally open" mode, long press the button2sTurn on, keep discharging2hDo not shut down. 3,Support smart power and high power mode selection, Pass resistorpinselect	1, Support dual-port simultaneous fast charging output, independent of each other support led and 188 Automatic Identification 2 ,support 2-6S Cell string number selection 3, supportpin Select power, full voltage,NTC and other functions 4,support SCP input Output

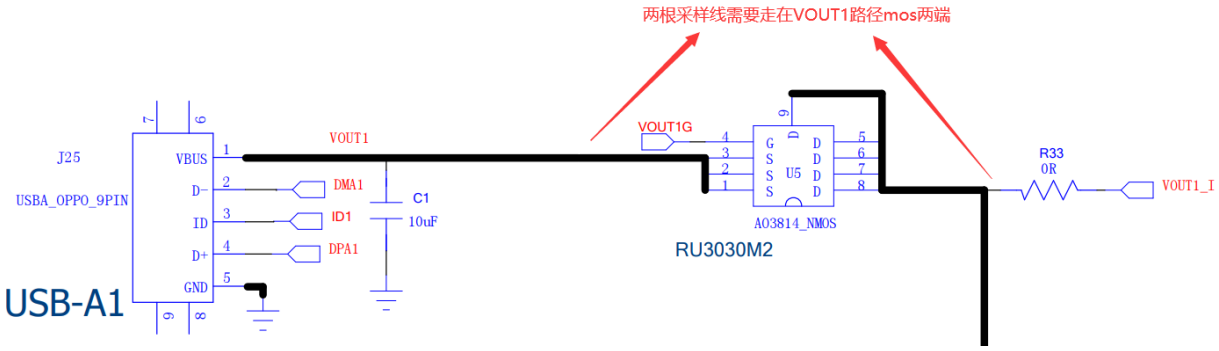
The protocols supported by each port of the above scheme are as follows:

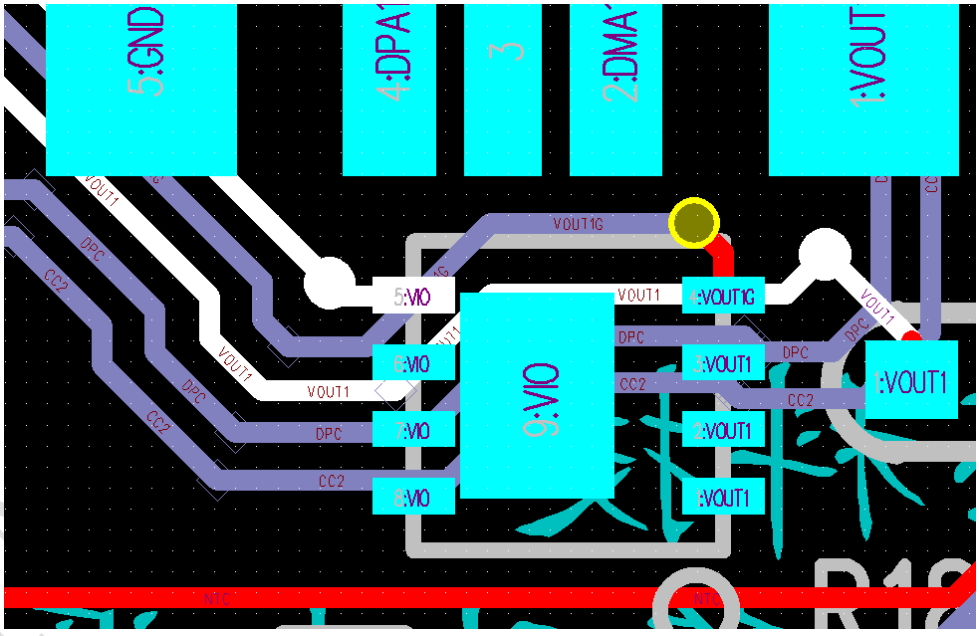
Input and output port	Supported fast charging protocols
USBAport output	QC2.0, QC3.0, FCP, AFC, low pressureSCP, low pressureVOOC
MicroBmouth input	AFC, high pressure SCP, FCP
Type-Cmouth input	PD, AFC, high pressure SCP, FCP
Type-Cport output	PD, QC2.0, QC3.0, FCP, AFC, high pressureSCP, low pressureVOOC
Lightningmouth input	PD (Highest12V)

two,IP5389 layoutLayout suggestions

1.Current sampling wiring of each output port

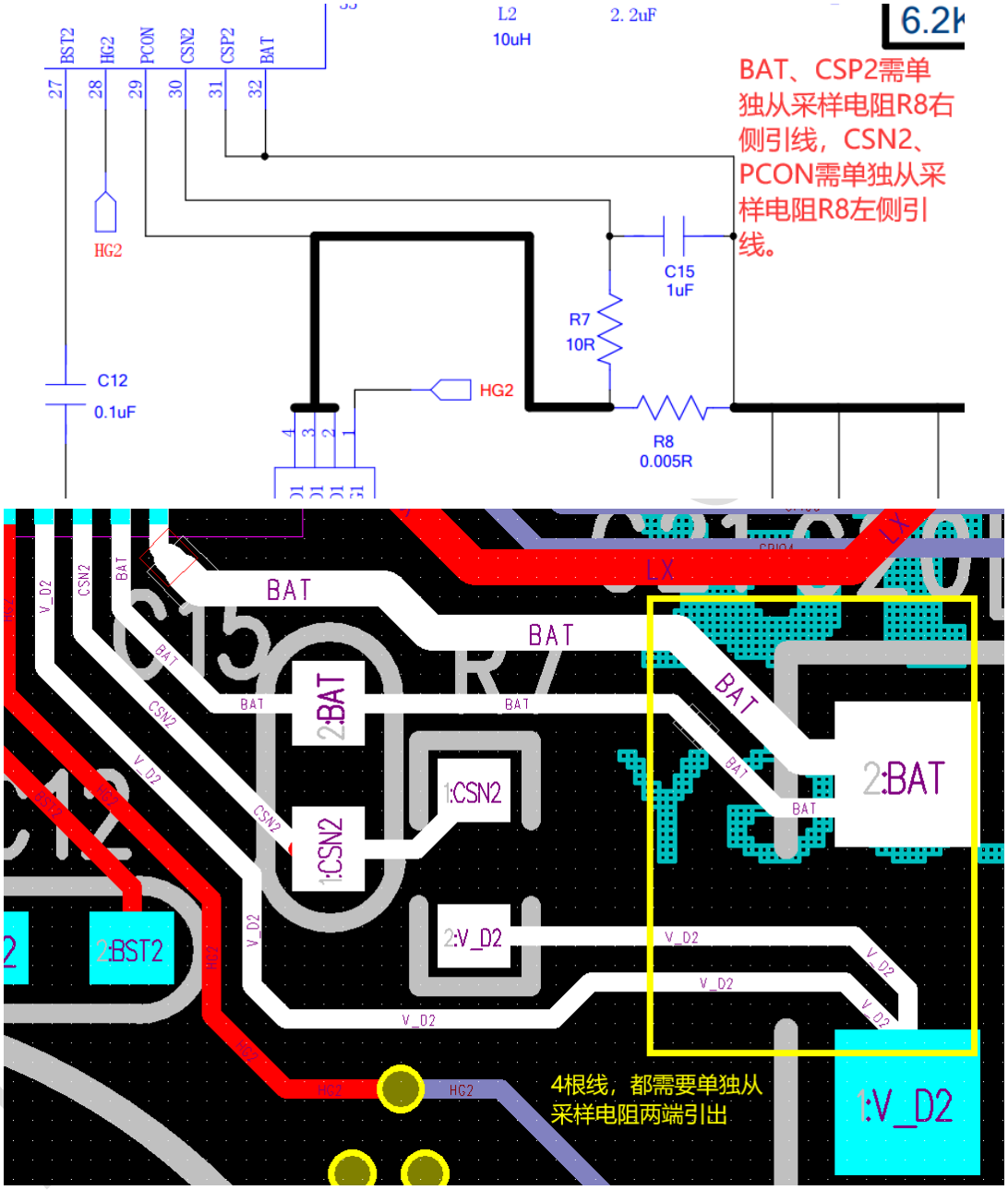
existIP5389, each output and input port has two sampling lines toVOUT1Taking the port as an example, the two sampling lines are named VOUT1andVOUT1_I. When routing, you need to VOUT1 and VOUT1_I**individually** Go toVOUT1pathMOS Both ends (pictured below). It is worth noting thatVOUT1_IandVIObelong to the same network, but they must not be directly connected to the nearby network at will.VIO In the network, you must follow the specified pathMOSedge.



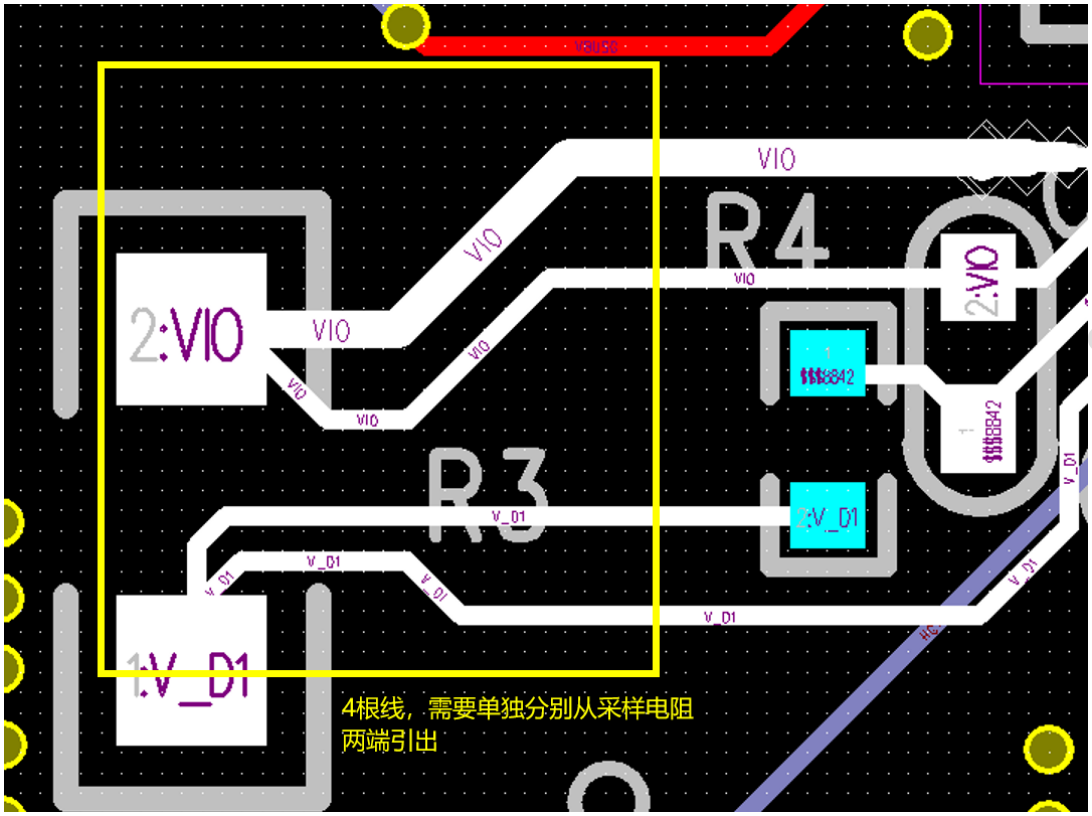


2.VIODuanheBATThe terminal sampling line needs to be led out from both ends of the sampling resistor separately, and the shorter the better.

In the schematic, the pinBAT,CSP2Belong to the same network, but when routing**must be separated separately**Lead from the right side of the sampling resistor;CSN2andPCONalso need**separately**Lead from the left side of the sampling resistor, as shown belowlayoutAs shown in the figure:

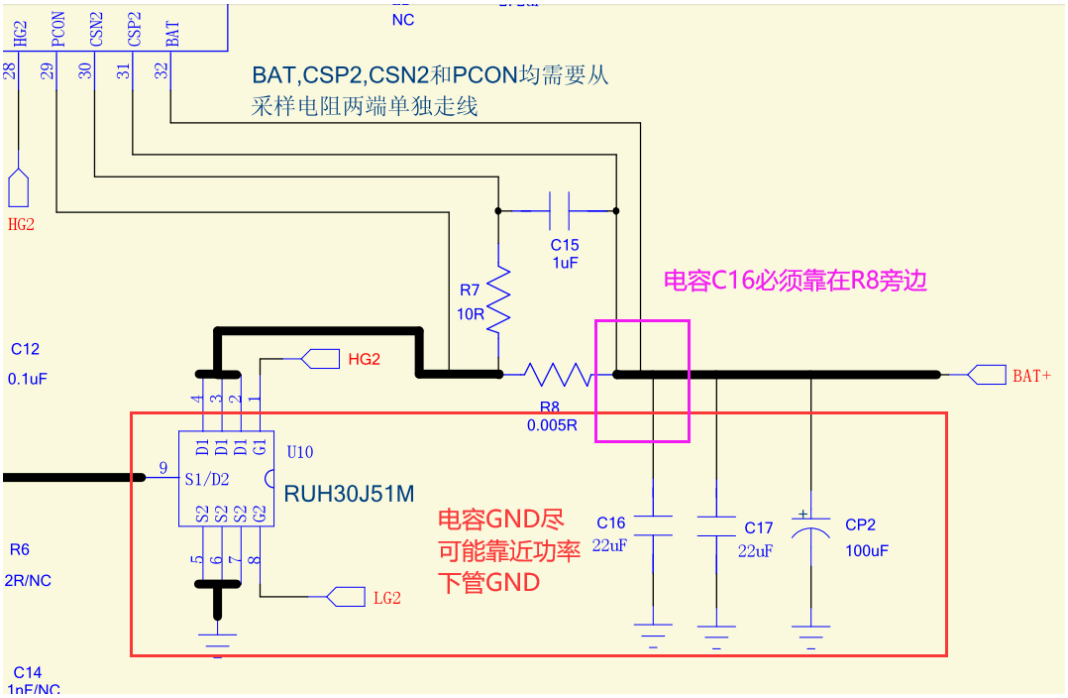


VIOThe sampling resistor wiring at the terminal is the same:



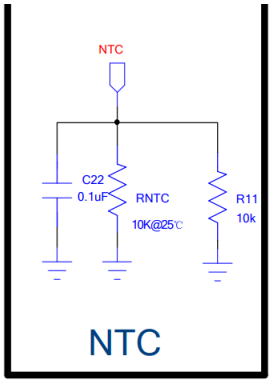
3.VIOandBATThe terminal capacitor needs to be close to the sampling resistor

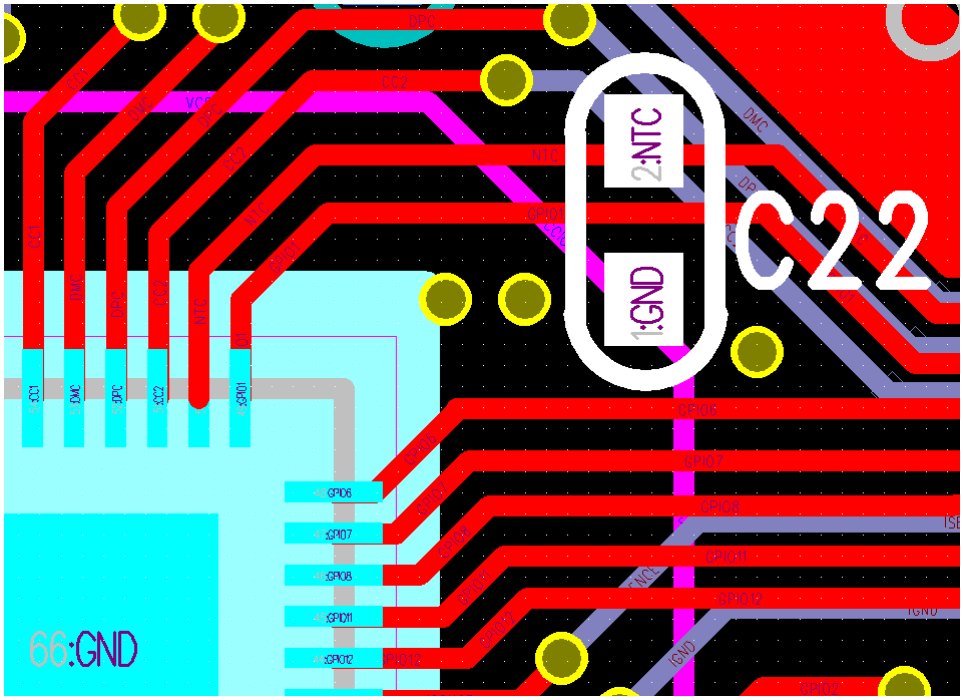
byBATterminal, for example, next to the sampling resistor of this terminal**Must be at least**place a22uFcapacitance. Under this premise, try to make the capacitor asGNDnearBATUnder the power circuitGND,in addition**The more holes in the ground, the better**. Otherwise, the current may beADC It affects the accuracy and stability of sampling.



4.NTCThe capacitor needs to be close toNTC pinfoot

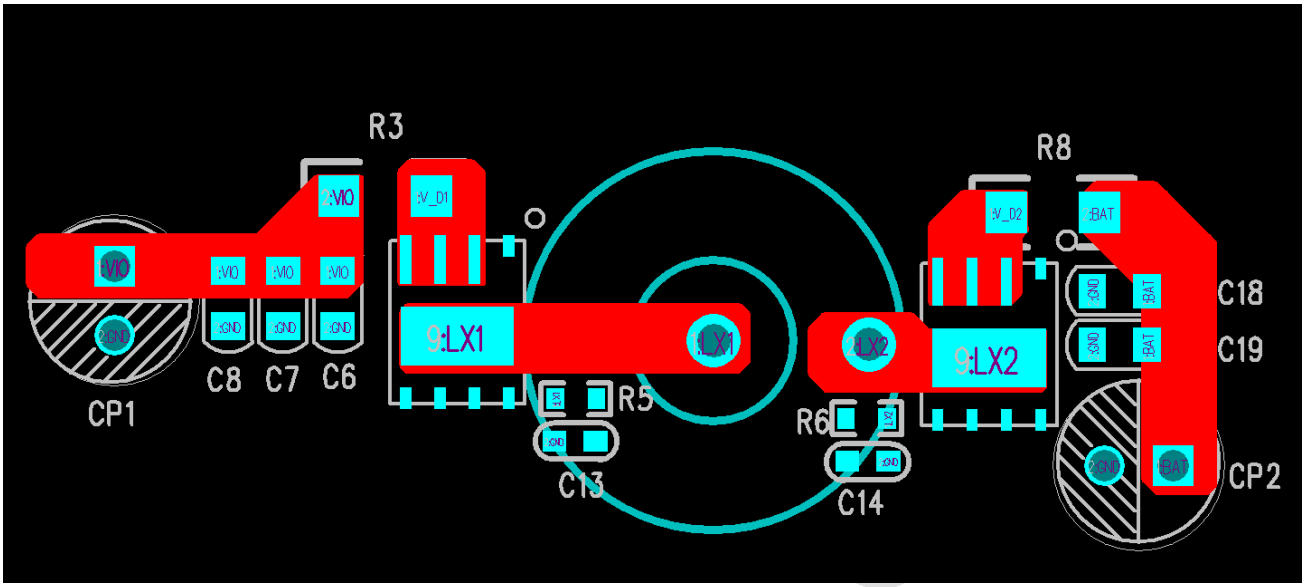
accomplishNTCFunction used0.1uFThe capacitor needs to be close toICofNTC pinfeet, as shown belowlayoutAs shown in the figure. In addition, no needNTCfunction, directlyNTC pinFoot connection10kJust connect the resistor to ground, useNTCWhen using the function, you need to change the10kresistanceNC.



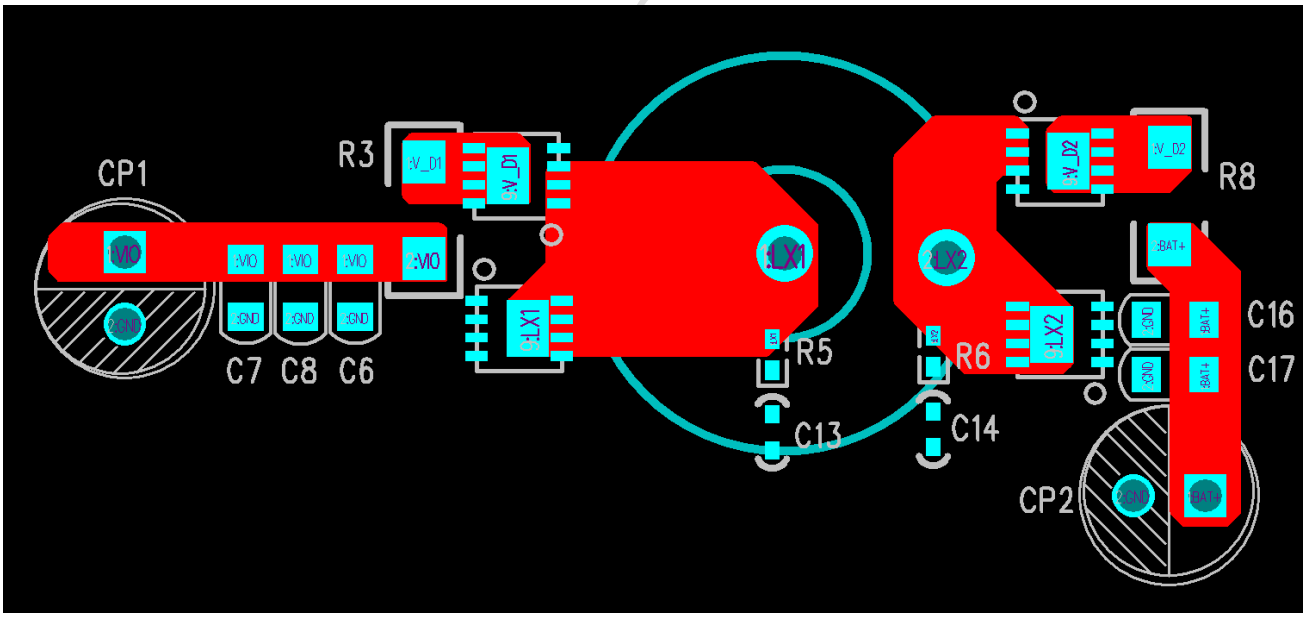


5.Power layout reference

For doubleNMOSand singleNMOSIn both cases, we provide the following two layouts for reference:



pairNMOSPower layout reference



oneNMOSPower layout reference

No matter which solution is adopted, please ensure that the negative terminal of the capacitor and the negative terminal of the power tube are sufficiently connected.

enough holes. In addition, in order to deal with ringing interference at the moment of switching, we recommend addingRCAbsorption loop.RCThe specific value needs to be determined according to the actual device model and layout. The largerCThe peak absorption capacity can be increased, but the consequent reduction in efficiency also needs to be considered. According to internal experiments, fixedRfor2R, at full load (100W) discharge situation, changeCThe value of , its impact on the maximum amplitude and efficiency of ringing is as follows:

R	C	Rings the most high amplitude	efficiency	efficiency ratio value, with 2R1nFfor benchmark

2R	10nF	42	0.9539	0.9945
2R	6.8nF	43.4	0.9558	0.9964
2R	3.3nF	44.4	0.9576	0.9983
2R	1nF	52.6	0.9592	1.0000

The amplitude of the ringing is positively related to the size of the output current, so it is necessary to choose the appropriate one according to the actual application scenario.RC Take value. We recommend that ifPMAX<=65W,we recommend2R 1nFofRCcombination ifPMAX>65W,we recommend2R 3.3nFThe combination.

three,IP5389Summary of frequently asked questions

Device selection related issues:

1,IP5389rightHbridgeMOSdriver requirements, such asCissCapacitance value, etc., how to match to achieve the highest efficiency.

Generally speaking, forHbridgeNMOS, our recommended parameters are as follows:

Various attributes	Recommended parameters
( )	<10mR
	>=30V
	>8V
	> 15A
	<1000pF
( )	<10ns
( )	<40ns

HbridgeNMOSThe main factors affecting efficiency include ( ), and ,IP5389of The driving voltage comes from VCC5V, the impact of parasitic capacitance on efficiency is relatively small, the main consideration is ( )The smaller the better, in ( )not much differences In this case, the smaller the parasitic capacitance, the better. Regarding the turn-on and turn-off times, the shorter the better.

2, the path of each input and output portNMOSHow to choose

Each input and output portNMOSJust as a path switch, the requirements for switching speed are not high. About on-resistance ( ), we recommend the pathNMOSof ( )<10mR., the smaller this value, the higher the overall efficiency. Resistant The pressure needs to be selected according to the actual situation. For example, the selected solution supports the highest20Vcharge and discharge, then the pathNMOSof The withstand voltage needs to be greater than20V(Taking into account the margin, it is recommended to be greater than25V); if the selected solution supports the highest15Vcharge and discharge, then the pathNMOSof The withstand voltage needs to be greater than15V(Taking into account the margin, it is recommended to be greater than20V).

3, How to select an inductor and why it is recommended to use it?10uHof inductance?

We defaultIP5389The power loop output current is , the switching frequency is ,Input voltage , the output voltage is . According to the specific requirements of the project, we set the above parameters as follows:

Various parameters	value
_	5V
_	20V
_	5V
_	20V
	250kHz
_	6A

Inductor ripple current Generally take0.2 ~0.4 , take here0.3times, then =1.8A, the inductor current calculation formula is as follows:

(igh)= +0.5*

( )= -0.5*

Calculated (igh)=6.9A, ( )=5.1A.

existBUCKIn working mode, let ( )=20V, ( )=5V, =1.8A,neglectNMOSOn-resistance, we get

The following formula:

( )= * = (-)* * 1

Calculated ( )=5.6uH,

existBOOSTIn working mode, let ( )=5V, ( )=20V, =1.8A, also ignoredNMOSOn-resistance,

The following formula is obtained:

( )= * = (-(-)* 1 -)* 1

we got ( )=8.3uH.

The inductance value of the inductor is10uHThat's it. The rated current depends on the specific usage scenario. Generally speaking, it needs to be at least greater than7A, the lower the DC impedance, the better.

4,CSP2/CSN2andCSP1/CSN1What is the sampling accuracy value of the feet? Resistors and voltages on the sampling circuit

What is the function of capacity and how to obtain its value?

The accuracy of current sampling is affected by the internal trimming reference, sampling amplification matching error, and the accuracy of the sampling resistor itself.PCB The influence of wiring and soldering effects. Without considering the error of the sampling resistor, the sampling accuracy can only be guaranteed to be <2%, to achieve higher accuracy, it is necessary to test the actual deviation during normal operation after the placement is completed, and modify the coefficient of the deviation through software.

We did a random test3pieceIP5389ofdemoboard, the average current sampling accuracy is within1.3%about. The resistor and capacitor on the sampling circuit function as a low-pass filter, and the resistance value is selected10R, capacity value selection1uF, then the cutoff frequency of the filter is16KHz, and the switching frequency (250kHz)difference16times, mainly to filter the switching ripple of the sampling current.

5, How to choose the capacitance value of the two bootstrap capacitors?

existIP5389, the power supply source of the bootstrap capacitor isVCC5V, in order to conduct the upper tubeBSTThe stability of the capacitor voltage generally needs to meet the 5> >> ,In most cases, =100 ,existHbridgeMOSof Does not exceed1nF (1000pF), the conventional value is100nF(0.1uF).

6. What is the appropriate amount of filter capacitor for each input and output port?

Generally speaking, it is recommended that the capacitance value of the output port should not exceed22uF, otherwise it may affectEMIThe certification has been passed, and excessive output capacitance may cause problems such as false triggering of load detection. So we recommend using10uF, you can also connect an additional one in parallel0.1uFcapacitance to reduceEMIinterference.

7, in practical applications,CC/D+/D-Generally, some resistors and capacitors are added. What are their values?

Formula?

In most cases, inCC/D+/D-The purpose of adding resistors and capacitors is to pass some certifications. The specific values are not easy to calculate theoretically. There are many factors that affect these parameters, such asPCBThe layout and wiring often need to be adjusted step by step on the actual board to finally get the appropriate parameters.

8,VIOandBATHow to choose the capacitor? whyVIOrecommend3indivual22uFin parallel1indivual100uF,and BATrecommend2indivual22uFin parallel1indivual100uF.

According to the capacitance calculation formula of switching power supply,VIOandBATThe minimum capacitance value of the capacitor is100uF, and considering that in actual use, the capacitance value may decrease as the use time increases or the temperature rises, we conducted a large number of charge and discharge experiments, and finally concludedVIOuse3indivual22uFand1indivual100uF,BATuse2indivual22uFand1indivual100uF Recommended parameters of the capacitor. In addition, the capacitance of each output port is only used for simple filtering.10uFThat's it.

Questions related to system functions:

1,AWhat is the load detection triggering logic of the port, and what is the detection voltage/load current value?

IP5389ofAThe port relies on detecting voltage to judge the load.AWhen the port is in standby,ICwill passVOUT1/VOUT2release one2.4VThe detection voltage reachesA1/A2port, the load capacity is5uA, when the load (equivalent impedance <400kΩ) is inserted, the output port's2.4Vwill be pulled low quickly when the voltage is below the trigger detection threshold (2.0V), it is determined that a load is inserted.

existIP5389When performing single-port fast charging and discharging, if the other output port detects load insertion, it will switch to dual-port at this time.5Vdischarge state. When it is detected that the current of an output port is less than the single port light load threshold (currently this value is80mA, default pathNMOSThe internal resistance is10mR), the output port will be closed, and then the remaining port can resume the fast charge and discharge state.

2,IP5389ofFCAPcapacitypinHow should the selection be used?

Here we describe it in detailIP5389ofFCAPcapacitypinSelect function by changingFCAPThe resistance value of the resistor to ground is used to configure different capacities. The capacity here refers to**Single series battery**capacity, for example,4Festival5000mahcells are connected in series, then the capacity configuration is5000mah, the resistor is set to5000/0.8=6.2kThat's it;4Festival5000mahThe battery cells are connected in parallel and then in series, then the number of cells here is selected2section, the capacity is configured as10000mah, the resistor is set to10000/0.8=12.4k.

3,IP5389In the application, how should the power and number of nodes match the settings?2Sections can be configured100W?

Since the current current limit value is maximum8.8A, and the shutdown voltage of currently supported lithium iron phosphate batteries is2.75V,2Lithium iron phosphate battery under low power outputBATThe maximum terminal power is2.75V*2*8.8A=48.4W, considering efficiency,VIOThe end is unsatisfactory 45Wdischarge, and in this case,BATThe current is very large and the heat will be serious, so we recommend2When saving battery,PMAXHighest configuration 30W. In the same way,3When saving battery, we recommendPMAXHighest configuration45W. Only when the number of batteries is greater than4During the holidays, we only recommendPMAX>=60W.

Additionally, configurePMAXfor65Wand100Wneed extraMarkCircuit, please refer to the schematic diagram for the specific circuit.

4,powerPMAXWhat power does it refer to, for example, configured as45W,AThe port can output45W?

PMAX Refers IP5389 of VBUS or VIN The maximum input and output power supported, VOU T The maximum port only supports output24W, at present IP5389 No I2C The program can only set the same input and output power. If you need to set different output and input powers, please use I2C plan.

when PMAX configured as 45W hour, VBUS support 45W Discharge. exist VIN as DCIn the plan of the mouth, VIN The maximum input power is also 45W,AThe port output power is still 24W.

5,VBUSmouth andVINWhen do I need to use a pair of tubes?

Normally VBUS mouth and VIN O rally use one N MOS It can be used as a path tube. When using it, pay attention to the source (S) toward the seat end, the drain (D) towardsVIOJust end it.

Generally, you need to set up peer management in the following two situations:

1, when passing some certifications, you need toVBUSThe port is set to the opposite tube to achieve the effect of complete shutdown in both directions. When using When using a pair of tubes, we recommend starting from the seat toVIOEnd according toD1---S1---S2---D2Place the pairs of tubes in this order. 2, when there is a mouthfulDCWhen inputting, you need to set the corresponding pipe in the port path. hypothesisVINmouth actDCenter,VBUS asType-Cport, if no pairing pipe is set, inVINWhen high pressure is inserted into the port, the high pressure will pass throughNMOSThe parasitic diode sinks directly into IP5389 of VIO on the path, if at this timeType-CGiving mobile phone5VCharging, because it cannot be turned off in timeVBUSpath pipe, this high pressure will also be poured intoVBUS, which is likely to cause damage to the phone.

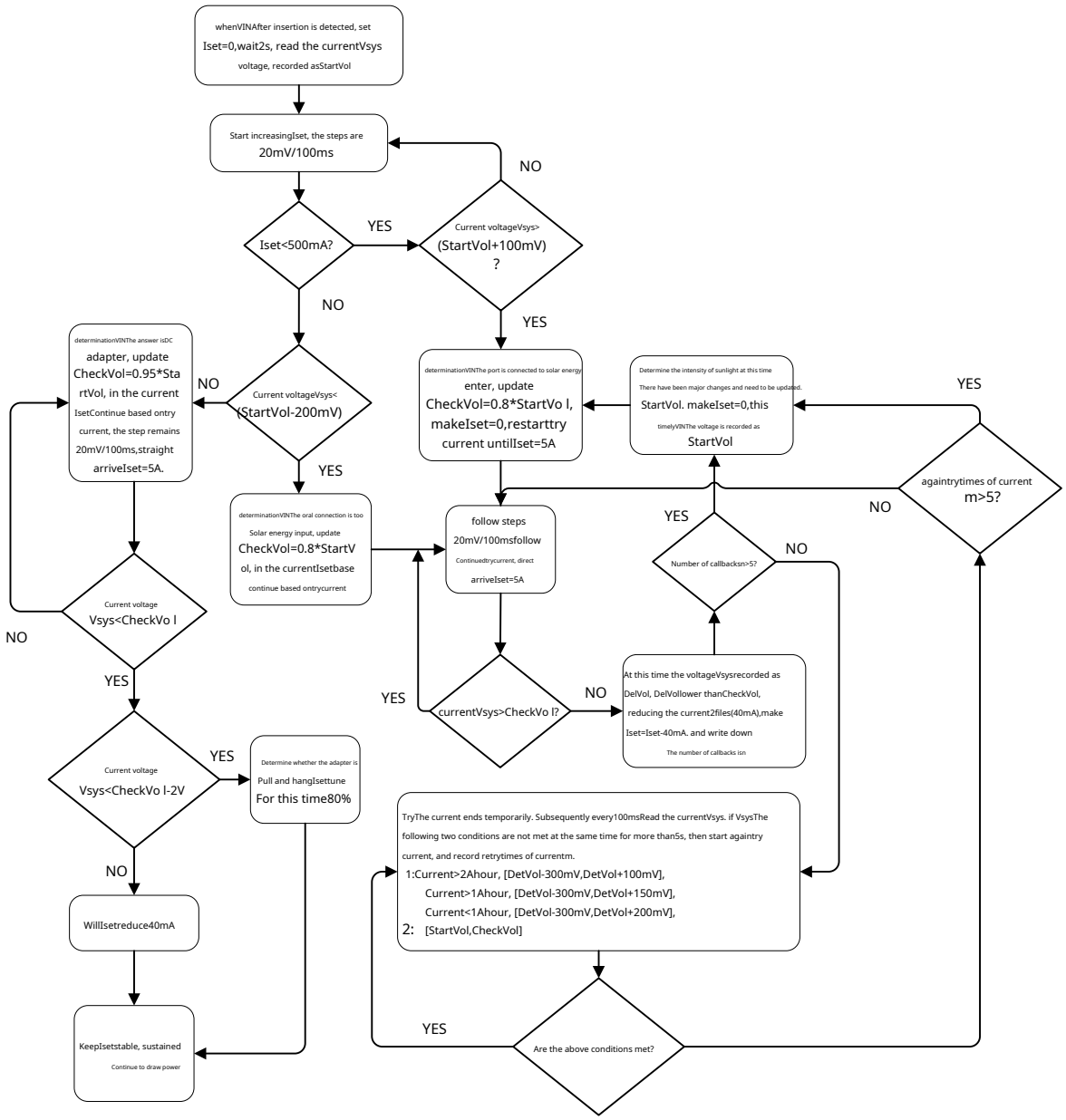
6,IP5389Can I freely burn firmware of different models?

Currently, it is not possible to burn firmware across models. One model IP5389 You can only burn the firmware of this model, and cannot burn the firmware of other models. When trying to use the burner we provide for cross-model burning, you will find that you cannot connect. You can also judge from this point IP5389 Whether it is the same model as the provided firmware.

7, can you describe it in detail?VINasDCWhat is the strategy for drawing current from the input port?

VINasDCInput port, equipped withMPPTFunction, its external power supply is generally divided into two categories:1, solar panel output; 2,DC output adapter. IP5389 will passtry To distinguish the above two types of power sources by the way of current, if it is a solar power source, ICIt will intelligently adjust the current extracted according to the output power of the solar power source in real time to maximize energy utilization. The current drawn is defined asIset,scope0~5A,DCWhen the mouth is working normally,Vsysneed to be satisfied4.5V~25V.

The following areVINoralMPPTFlow chart:



8. When charging, I find that the current takes a long time to start to increase, and the increase is very slow. Is this normal?

IP5389 This is the charging mechanism. detected VIN/VBUS After there is power, you need to deal with the status of multiple ports first and determine the status of other ports before entering the charging state. This time is approximately 2s. The subsequent slow increase in current is to prevent the adapter from overcurrent protection.

9, why I set the battery to end4section, battery full voltage 4.2V, set up VBAT=13V Power on, activate

After the battery is still 0?

Currently, when powering on for the first time, ifVBAT<N*3.4V, the electric power is judged as0. The main reason is that if the lithium battery is shut down early during the last high-power discharge, then after the subsequent charging is activated, the battery will suddenly become a very low battery.0In order to avoid this situation, the above modifications were made.

10. In the actual application process, can some output ports be deleted? If so, what are the corresponding output ports?

FunctionpinHow should this be handled?

can delete.

If the deleted output port isUSB-Aport, for example, in an application, there is no needUSB-A2mouth, then withUSB-A2 relatedVOUT2,DPA2,DMA2,VOU2_IIt will have no effect. At this time, you canIP5389ofVOUT2 , DPA2,DMA2pin is left floating whileVOUT2_Iyou need to pass a10kPull up toVCCIO.

If what is deleted isType-Cmouth orMicro-Bport, then the corresponding pin can be left floating directly.

11,use I2C version of the program, why IP5389 Still unable to shut down?

First check against the register documentIP5389registers related to light load shutdown to see if the light load shutdown function is turned off; then check whether the light load shutdown function is turned off.INTIt has been pulling higher and is currently atIP5389When it's time to shut down,ICwillINT Configured as an input to detect external voltage, if it is high, it will not shut down.

12, whether it is possible to add an exceptionIOmouth, inIP5389Notify in time when exceptions occurMCU?

at present IP5389 of IN T There is this function, please refer to IP5389 register file, in0xEAof0x0Cofbit6, which can be written as1, followed byIP5389When an exception occurs, INTevery interval 500msIt will be pulled down once, every time1~2ms. MCU It can be judged by detecting this signalIP5389Whether an exception occurs.

13, whyCThe port output only supports high voltageSCP?

exist IP5389 ofCWhen charging a Huawei mobile phone through the port, the mobile phone applies first PD High pressure agreement, will apply later SCP, so we will give priority to using high voltageSCPAgreement to charge Huawei mobile phones.

We turned it downCLow voltage at port outputSCPpriority, deletedCPort output supports low voltageSCPinstruction of. but not removedClow pressure in mouthSCPOutput function, so when using a decoy device for testing, you can also decoy low voltage alone.SCP of.