Output 45W Power Buck SOC with Multiple Fast Charge Protocols

1 Features

- **Synchronous Step-Down Converter**
  - Built-in Power MOSFETs
  - Input Voltage Range, 7.2V to 32V
  - Output voltage range: 3V~21V
  - Output voltage line complement function
  - Output power support CV/CC mode
  - VIN=24V, VOUT=5V@3A, Conversion efficiency up to 93.6%
- **Support Type-C Output and PD Protocol**
  - Support 5V, 9V, 12V,15V,20V output
  - Support PD2.0/PD3.0/PPS output protocol
  - PPS support 3~21V adjustable voltage with 20mV/step output
- **Fast Charge Output**
  - Support Type-C PD output
  - Support BC1.2 and Apple
  - Support QC2.0, QC3.0 andQC3+
  - Support MTK PE+2.0 and PE+ 1.1
  - Support Huawei Fast charge FCP
  - Support Samsung fast charge AFC
  - Support SFCP
- **Multi-Protection and High Reliability**
  - Input overvoltage, input under voltage
  - Output short circuit, output overcurrent protection
  - Over temperature protection
  - DP/DM/CC over voltage protection
  - CC withstand voltage of 30V
  - HBM ESD 4KV
- **Package: 4*4mm QFN24**

2 Application

- **Car Charger**
- **Fast Charge Adapter**

3 Introduction

IP6537U is a synchronized switch buck regulator which supports multiple fast charge output protocols, providing solutions for car charger and charge adaptor.

IP6537U has built-in power MOSFET, input voltage range is 7.2V to 32V, output voltage ranges from 3V to 21V, and supply up to 45W output power, can automatically adjust the output voltage and current according to the identified fast charging protocol.

IP6537U output power has CV/CC characteristic. when the output current is lower than the preset value, it is in CV mode with a constant output voltage; when the output current is higher than the preset value, it enters CC mode and the output voltage decreases as the output current increases.

The PIN15 and PIN16 of IP6537U can be used as intelligent power reduction control function, connecting two external resistances can simply use two IP6537U to realize dual-port intelligent power-reduced function.

IP6537U supports soft start, providing resistibility on the large inrush current during circuit start up.

IP6537U supports multiple protection on input overvoltage and under voltage, output overcurrent, overvoltage, under voltage and short circuit

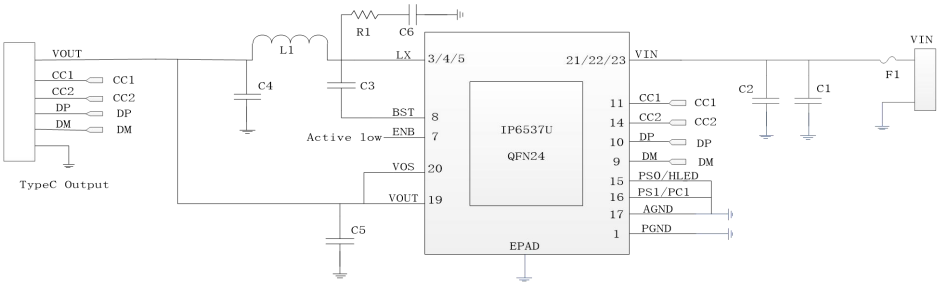


Fig.1 IP6537U Simplified Application Schematic

Content

4 Revision History

Notes: The page number of the previous version may different from the page number of the current version

Initial Release V 1.00 (May 2023)

Changes from Revision V1.00 (May 2023) to Revision V1.1(Nov 2023) **Page**

5 Typical Application Schematic Diagram

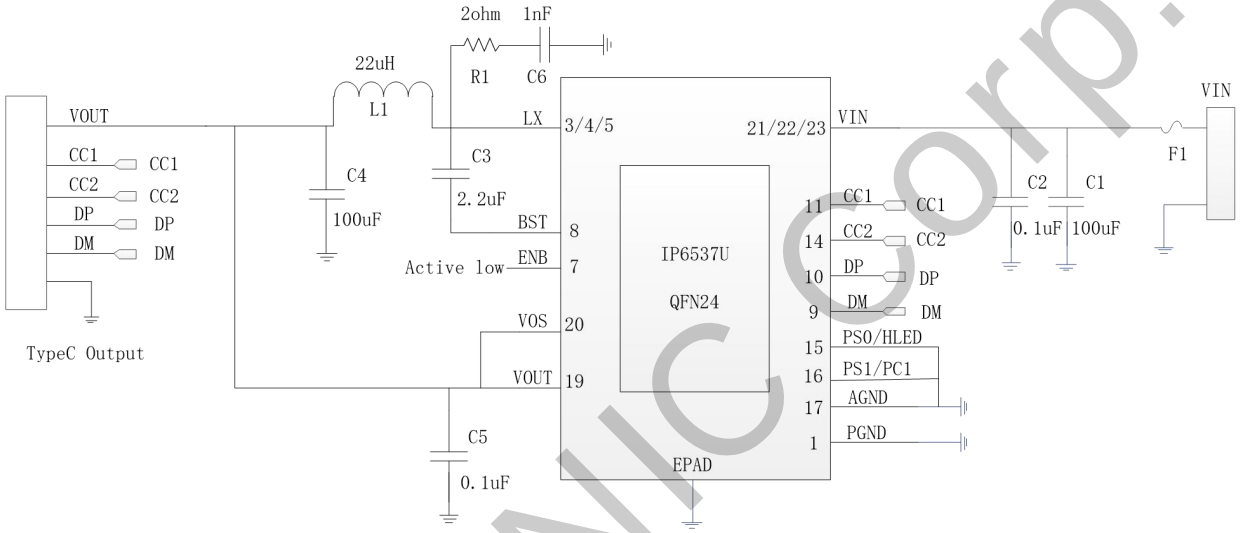


Fig. 2 IP6537U Application Schematic of Single Type-C Port PD Fast Charging Output

Notes:

(1) IP6537U EPAD must have a good contact with PCB GND;

(2) ENB cannot be floating and needs to be given a definite level; the chip turns on when ENB is low and turns off when ENB is pulled up to 2V or more;

(3) C1 and C2 should be placed close to the PIN21/PIN22/PIN23 of IP6537U; C2 requires an appropriate increase in capacitance if it is far from the 100uF capacitor or the power supply VIN;

(4) C5 should be placed close to the PIN19/PIN20 of IP6537U;

(5) R1 and C6 should be placed close to the LX (PIN3/PIN4/PIN5) of IP6537U, and the loop composed of LX pin, R1, C6 and PGND should be minimized on the PCB board;

(6) When the USB port on the program does not use DP and DM pin, the DP and DM interface should be reserved on the PCB to facilitate subsequent upgrades of the device.

6 PIN Definition

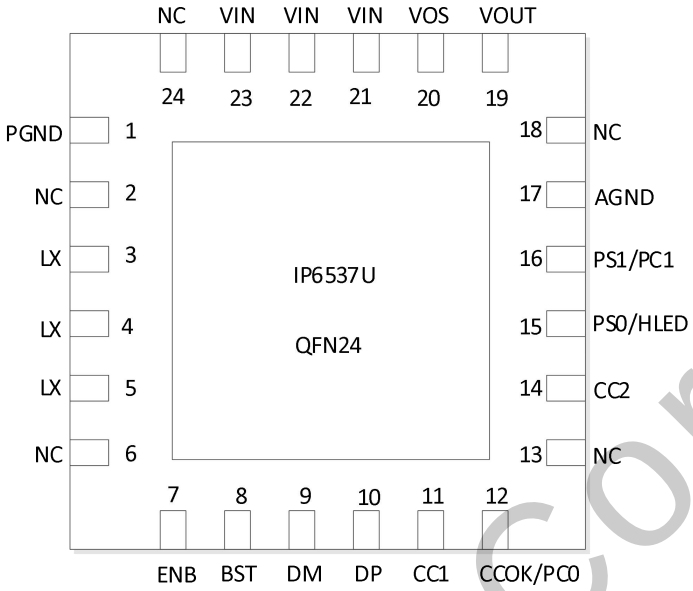


Fig. 3 IP6537U PIN Configuration

Pins		Description
Pin NO.	Pin Name	
1	PGND	Power ground
2/6//13/18/24	NC	Floating pin
3/4/5	LX	Power switch node, connected to external inductor
7	ENB	Chip enable pin, cannot be suspended. Chip enable when ENB is pulled low externally
8	BST	Bootstrap capacitor pins
9	DM	USB C port fast charge communication pin DM
10	DP	USB C port fast charge communication pin DP
11	CC1	USB C port detection and fast charge communication pin CC1
12	CCOK/PC0	CC connecting indication PIN/Power control PIN 0
14	CC2	USB C port detection and fast charge communication pin CC1
15	PS0/HLED	Intelligent power reduction control pin 0/ Fast charging mode indication pin
16	PS1/PC1	Intelligent power reduction control pin 1/Power control PIN 1
17	AGND	Analog ground
19	VOUT	VOUT output current negative sense pin
20	VOS	VOUT output current positive sense pin
21/22/23	VIN	Input voltage node
25	EPAD	Power ground

7 IP Series Model Selection Table

7.1 IC Selection Table

IC Model	Output current	Dual ports	Supported Protocols										Package	
			DCP	QC2.0	QC3.0	FCP	SCP	AFC	MTK PE	SFCP	PD2.0	PD3.0 (PPS)	Pkg	P2P
IP6536	2.4A	√	√	-	-	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP6523S_NU	3.4A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	
IP6525TQ	18W	-	√	√	√	√	-	√	-	-	-	-	ESOP8	
IP6525T_NU	18W	-	√	√	√	√	-	√	-	-	-	-	ESOP8	PIN2PIN
IP6525S	18W	-	√	√	√	√	√	√	√	√	-	-	ESOP8	
IP6525S_OC	18W	-	√	√	√	√	√	√	-	√	-	-	ESOP8	
IP6520	18W	-	√	√	√	√	√	√	√	-	√	-	ESOP8	PIN2PIN
IP6520T	20W	-	√	√	√	√	-	√	-	-	√	-	ESOP8	
IP6520T_PPS	20W	-	√	√	√	√	-	√	-	-	√	√	ESOP8	
IP6537_C	18W	-	√	√	√	√	√	√	√	√	√	√	QFN24	PIN2PIN
IP6537_C_30W20V	30W	-	√	√	√	√	√	√	√	√	√	√	QFN24	
IP6537U_C	18W	-	√	√	√	√	-	√	√	√	√	√	QFN24	
IP6529_C	27W	-	√	√	√	√	-	√	-	-	√	√	QFN24	
IP6538U_AA	24W	√	√	√	√	√	√	√	√	-	-	-	QFN32	PIN2PIN
IP6538U_AC	27W	√	√	√	√	√	√	√	√	-	√	√	QFN32	
IP6551	4.8A	√	√	-	-	-	-	-	-	--	-	-	QFN32	
IP6527U_A	24W	-	√	√	√	√	√	√	√	-	-	-	QFN32	PIN2PIN
IP6527U_C	27W	-	√	√	√	√	-	√	√	-	√	√	QFN32	
IP6559_C	100W	-	√	√	√	√	√	√	-	-	√	√	QFN64	PIN2PIN
IP6559_AC	100W	√	√	√	√	√	√	√	-	-	√	√	QFN64	
IP6557_C	140W	-	√	√	√	√	√	√	√	√	√	√	QFN40	

7.2 IP6537U Series Product Selection

Product	USB	Output Power					
IP6537U_C	USB Type-C	18W PDO	5V/3A	9V/2A	12V/1.5A	3.3-5.9V/3A	3.3-11V/2A
		QC	5V/3A	9V/2A	12V/1.5A		
IP6537U_1_35W_ 27W5_7W5	USB Type-C	35W PDO	5V/3A	9V/3A	15V/2.33A	20V/1.75A	3.3-11V/3A
		27.5W PDO	5V/3A	9V/3A	15V/1.83A	20V/1.37A	
		17.5W PDO	5V/3A	9V/1.94A	15V/1.16A	20V/0.87A	
		7.5W PDO	5V/1.5A	9V/0.83A	15V/0.5A	20V/0.37A	
IP6537U_2_35W_ 27W5_7W5	USB Type-C	35W PDO	5V/3A	9V/3A	15V/2.33A	20V/1.75A	3.3-11V/3A
		27.5W PDO	5V/3A	9V/3A	15V/1.83A	20V/1.37A	
		17.5W PDO	5V/3A	9V/1.94A	15V/1.16A	20V/0.87A	
		7.5W PDO	5V/1.5A	9V/0.83A	15V/0.5A	20V/0.37A	
IP6537U_3_35W_ 20W_15W	USB Type-C	35W PDO	5V/3A	9V/3A	15V/2.33A	20V/1.75A	3.3-11V/3A
		20W PDO	5V/3A	9V/2.22A	12V/1.67A		
		15W PDO	5V/3A	9V/1.67A	12V/1.25A		
IP6537U_4_35W_ 20W_15W	USB Type-C	35W PDO	5V/3A	9V/3A	15V/2.33A	20V/1.75A	3.3-11V/3A
		20W PDO	5V/3A	9V/2.22A	12V/1.67A		
		15W PDO	5V/3A	9V/1.67A	12V/1.25A		
IP6537U_5_35W_ 20W	USB Type-C	35W PDO	5V/3A	9V/3A	15V/2.33A	20V/1.75A	3.3-11V/3A
		20W PDO	5V/3A	9V/2.22A	12V/1.67A		

Notes:

1. IP6537U supports a maximum power output of 45W (20V/2.25A).
2. The PS0/HLED PIN and PS1/PC1 PIN Pins of the IP6537U can be multiplexed for other functions as required.
3. The QC fast charging output of IP6537U in the table are 18W, and support CV/CP/CC loops.

8 Internal Block Diagram

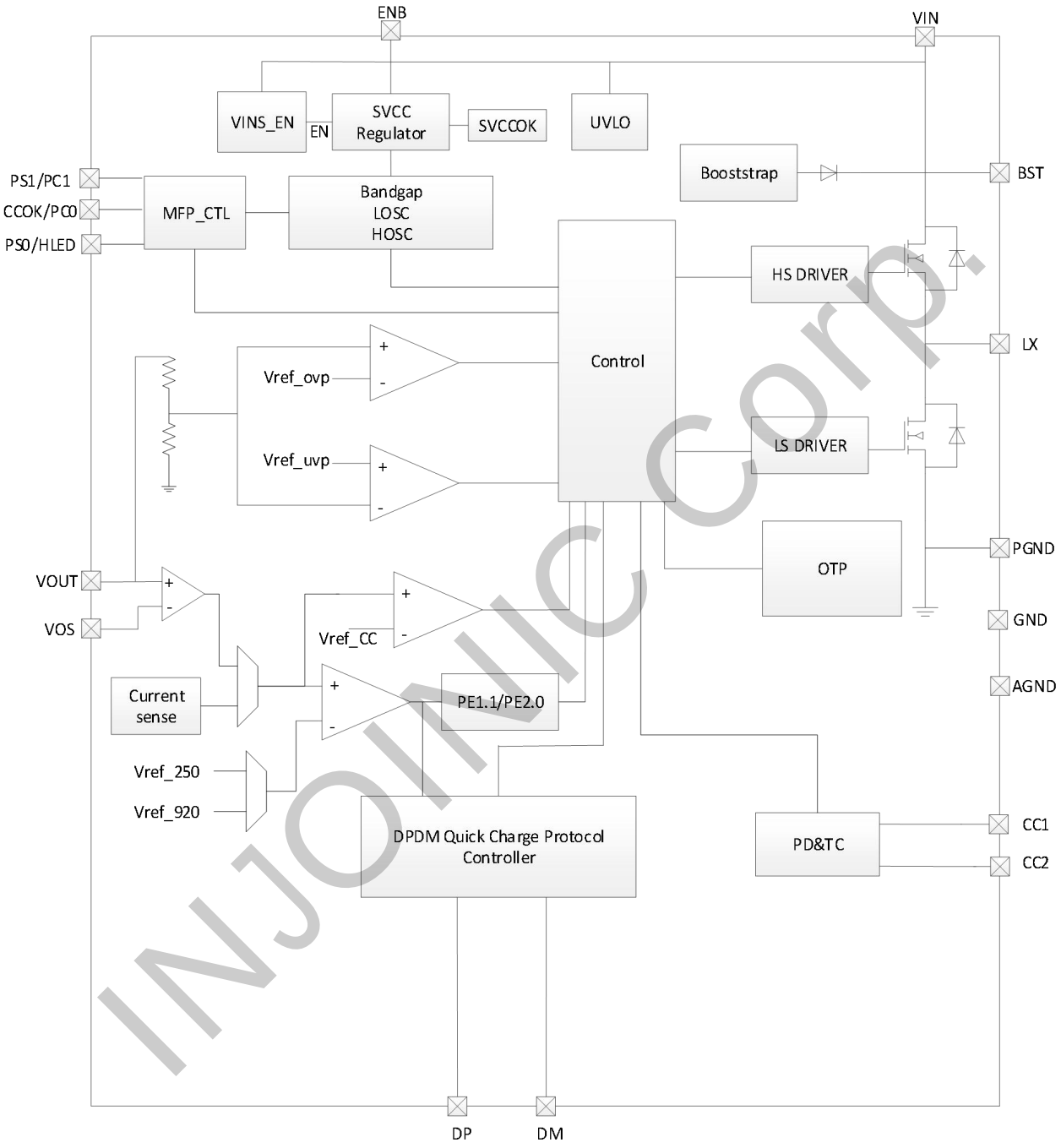


Fig. 4 IP6537U Internal Block Diagram

9 Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Input voltage range	V_{IN}	-0.3 ~ 40	V
LX voltage range	V_{LX}	-0.3 ~ VIN+0.3	V
VOUT voltage range	V_{VOUT}	-0.3 ~ 30	V
DP/DM/CC voltage range	$V_{DP/DM/CC1/CC2}$	-0.3 ~ 6	V
Junction Temp range	T_J	-40 ~ 150	℃
Storage Temp range	Tstg	-60 ~ 150	℃
Thermal resistance (junction to ambient)	θ_{JA}	40	℃/W
ESD（HBM）	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.

10 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	V_{IN}	7.2	12/24	32	V

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

11 Electrical Charateristics

Unless otherwise specified, TA=25℃, L=22uH, VIN=24V, VOUT=5V, tested on the IP6537U_C demo.

Parameters	Symbol	Test Condition	Min.	Typ.	Max	Unit
Input system						
Input voltage	V_{IN}		7.2	24	32	V
Input under voltage	V_{IN-UV}	Rising voltage	7.1	7.2	7.3	V
	$V_{IN-UV-TH}$	Falling voltage	-	0.3	-	V
Input over voltage	V_{IN-OV}	Rising voltage	31.4	31.7	32.0	V
	$V_{IN-OV-TH}$	Falling voltage	-	0.2	-	V
Input quiescent current	I_Q	VIN=24V, Standby status	-	400	-	uA
Shutdown current	I_{SD}	Input current at ENB=3.3V, VIN=24V	-	25	-	uA
Power switching system						
High-side MOS Ron resistance	$R_{DS(ON)\_L}$		-	30	-	mΩ
Low-side MOS Ron resistance	$R_{DS(ON)\_H}$		-	20	-	mΩ
Maximum Duty Cycle	D_{MAX}	VIN = 9V，VOUT=9V/3A	-	98	-	%
Switching frequency	F_S		90	110	130	KHz
Output system						
Output voltage	V_{OUT}		3	5	21	V
Output voltage ripple	ΔV_{OUT}	VIN=12V，VOUT=5V/3A	85	90	95	mV
		VIN=12V，VOUT=9V/2A	85	90	95	mV
		VIN=24V，VOUT=12V/1.5A	90	95	100	mV
		Note: Typical values tested under the demo board reference design				
Soft start time	T_{SS}	VIN = 24V，VOUT = 5V	-	4	-	ms
Output line compensate voltage	V_{COMP}	VIN = 24V，VOUT = 5V，IOUT = 3A	-	150	-	mV
Max output current in CC mode (IP6537U_C)	I_{OUT}	VIN = 24V，VOUT = 5V	-	3	-	A
		VIN = 24V，VOUT = 9V	-	3	-	A
		VIN = 24V，VOUT = 12V	-	1.5	-	A
Output hiccup restart voltage	V_{OUT}	Hiccup restart voltage when output enter CC	-	4.1	-	V

		mode (VOUT preset voltage >= 5V)				
Parameters	**Symbol**	**Test Condition**	**Min.**	**Typ.**	**Max**	**Unit**
Output hiccup restart voltage	V_{OUT}	Hiccup restart voltage when output enter CC mode (VOUT preset voltage < 5V)	-	3	-	V
Output hiccup restart time	T_{HIC}	VIN=24V, VOUT short circuit	-	2	-	S
DPDM over voltage protection voltage	V_{OVP_DPDM}	VIN = 24V，VOUT=5V	-	4.5	-	V
CC over voltage protection voltage	V_{OVP_CC}	VIN = 24V，VOUT=5V	-	6.0	-	V
Thermal shutdown temperature	T_{OTP}	Rising temperature	-	150	-	℃
Thermal shutdown temperature hysteresis	ΔT_{OTP}		-	40	-	℃
ENB PIN						
ENB Input shutdown voltage	$V_{ENB-OFF}$	Input voltage of ENB rises to turn the device off	2	-	-	V
ENB Input turn-on voltage	V_{ENB-ON}	Input voltage of ENB drops to turn the device on	-	-	0.5	V
ENB Input turn-on delay time	T_{ENB-ON}	Delay time form ENB input is low to DCDC on	-	170	-	ms
ENB Input shutdown delay time	$T_{ENB-OFF}$	Delay time form ENB input is high to DCDC off	-	50	-	μs

12 Function Description

12.1 Synchronized Switch Buck Regulator

IP6537U integrate a high efficiency synchronous switching buck converter, which supports a wide input voltage range of 7.2V to 32V, and an output voltage range of 3.0 to 21V.

IP6537U integrate power switch MOSFET with 110kHz working frequency.

The conversion efficiency is up to 93.6% at VIN=24V, VOUT=5V@3A. The efficiency under different input voltage and load current is shown in Fig. 5. and Fig. 6 shows the output voltage characteristics under different load current.

IP6537U automatically adjusts the output voltage and current based on the recognized fast charging protocol.

IP6537U has a soft-start function to prevent malfunction caused by excessive inrush current at startup. Soft-start time is 4 ms for VIN=24V and 5V no-load output.

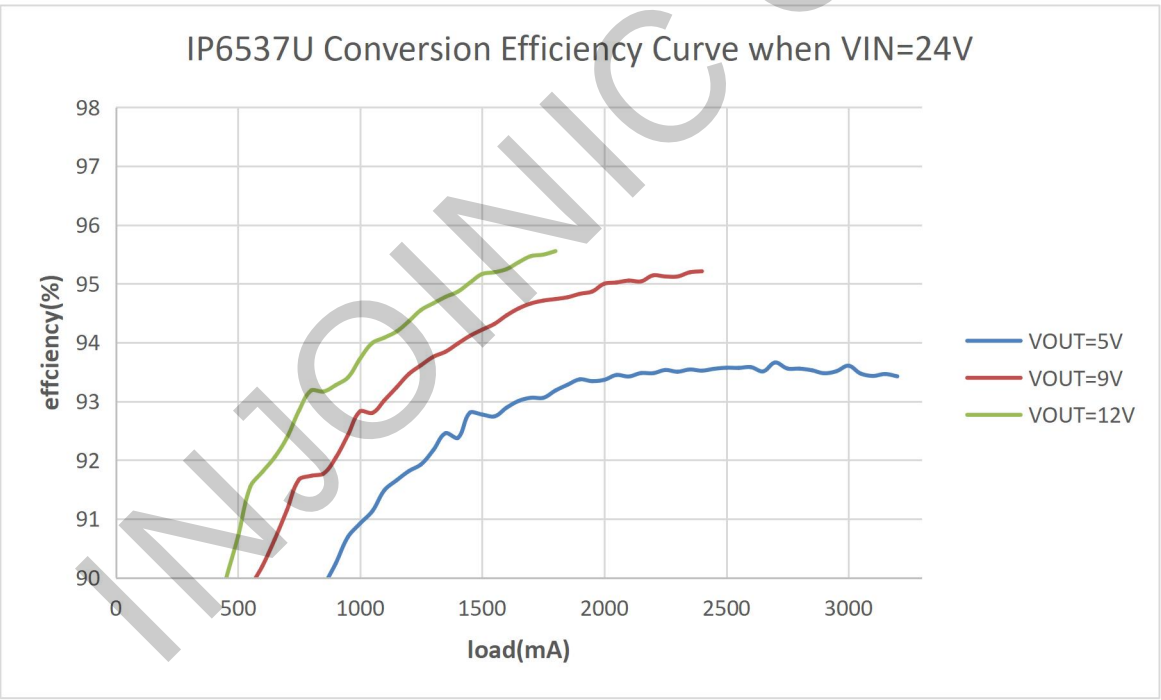


Fig. 5 IP6537U_C Conversion Efficiency Curve when VIN=24V

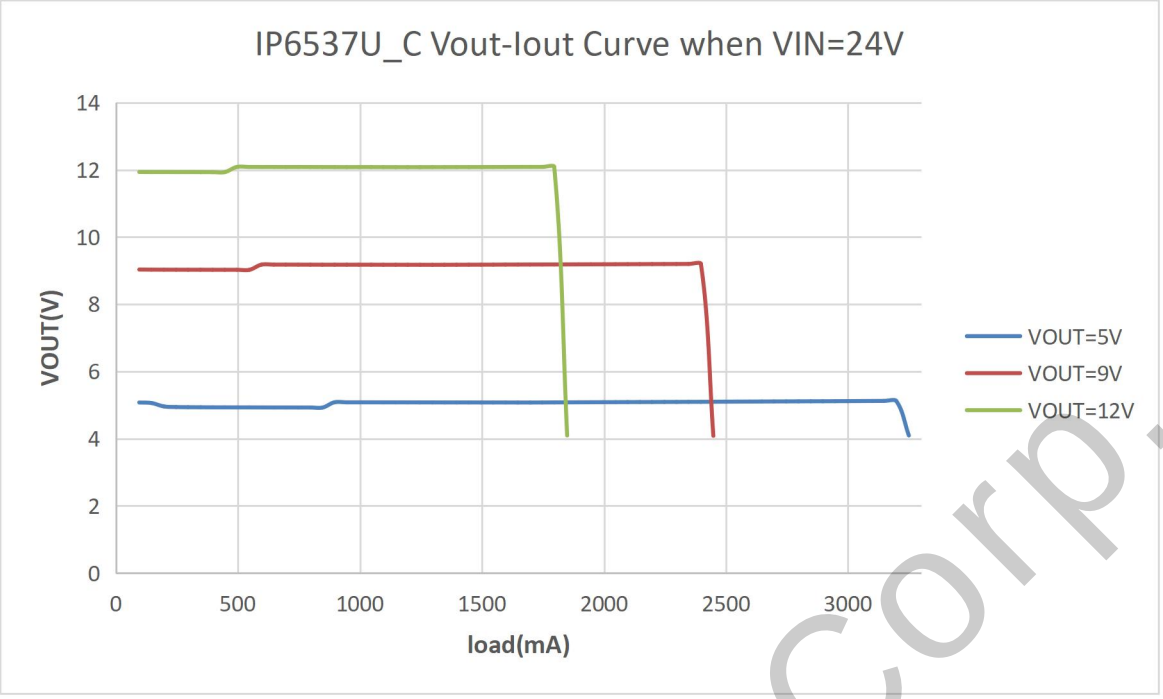


Fig. 6 IP6537U_C Vout-Iout Curve when VIN=24V

12.2 Output Voltage Line Complement Function

IP6537U supports output line compensate, output voltage will increase about 50mV as output current increase 1A.

12.3 Output CC/CV/CP Characteristic

When IP6537U works with QC high voltage protocol ,IP6537U supports output CV/CP/CC. when the output current is lower than the preset value, output is CV mode with constant output voltage; while the output current is higher than the preset value, output is CP mode, as the load increases, the output voltage decreases; when the voltage drops to 6.5V, CC mode is entered, The load continues to increase and the output voltage rapidly decreases until the output voltage undervoltage protection is triggered.

When IP6537U works with PD high voltage protocol, IP6537 supports output CV /CC, when the output current is lower than the preset value, output is CV mode with constant output voltage; while the output current is higher than the preset value, output is CC mode, The load continues to increase and the output voltage rapidly decreases until the output voltage undervoltage protection is triggered.

When VOUT preset voltage is higher or equal to 5V, if the load continues to increase, output voltage is lower than4.1V, the output will be shut down and hiccup restart after 2sec; When VOUT preset voltage is lower than 5V, if the output voltage is lower than 3V, the output will be shut down and hiccup restart after 2sec.

12.4 Protections

IP6537U supports input undervoltage protection: When the VIN voltage is lower than 7.3V, IP6537U detects the input undervoltage and turns off the output.

IP6537U supports input over voltage protection: When the VIN voltage is higher than 32.7V, IP6537U will turns off the output. When the VIN drops under 31.5V, IP6537U will consider the VIN normal and turn on the output.

IP6537U supports output under voltage protection: When VOUT preset voltage is higher or equal to 5V, if the VOUT voltage is lower than 4.1V, IP6537U determines the output is under voltage and will turn off the output and hiccup restart after 2sec. When VOUT preset voltage is lower than 5V, if the output voltage is lower than 3V, the output will be turned off and hiccup restart after 2sec.

IP6537U supports short circuit protection: 8ms after the circuit is started, if VOUT voltage is under 4.1V, IP6537U determines the output is short circuit and will turn off the output and hiccup restart after 2sec.

IP6537U supports DP/DM/CC over voltage protection, when DP/DM voltage is higher than 4.5V, or CC1/CC2 voltage is higher than 6.0V, IP6537U determines relevant signal PIN is over voltage and will turn off the output and hiccup restart after 2sec.

IP6537U supports over temperature protection: when the temperature detected is higher than 150℃, the output will be turned off. When the temperature decreases below 110℃, IP6537U determines the temperature has recovered and will restart the output.

12.5 Fast Charge Protocols

IP6537U supports multiple fast charge protocols:

- Support DCP (BC1.2 and Apple)
- Support Qualcomm quick charge QC2.0, QC3.0 and QC3+
- Support MTK PE+2.0 and PE+ 1.1
- Support Huawei FCP
- Support Samsung AFC (MAX 12V)
- Support SFCP

12.6 Type-C Port and USB PD Protocol

IP6537U_C supports Type-C output and USB PD2.0/PD3.0 (PPS) protocol.

IP6537U_C supports USB PD protocol output 18W; Package broadcast: 5V/3A, 9V/2A, 12V1.5A, PPS 3.3-5.9V/3A, 3.3-11V/2A.

IP6537U supports the standard Type-C specification and will not turn on the output until the CC connection is successful.

IP6537U Type-C port detects the fast charge requirement automatically through DP/DM and CC1/CC2 pins and adjusts the output voltage and current accordingly.

12.7 ENB PIN Function

ENB is an external enable pin, which cannot be suspended and needs to be given a definite level; The chip turns on when ENB is low and turns off when ENB is pulled up to 2V or more;

ENB is 3.3V, the shutdown current at 24V input is 25uA.

ENB can not be connected to a high-voltage of 6V or more, otherwise it will cause this PIN overvoltage breakdown.

12.8 MFP Function

CCOK/PC0 (PIN 12) of IP6537U can be multiplexed as CC connection indication function or power selection control function. Used as CC connection indication function, IP6537U will output 1 when CC is connected properly, or IP6537U will output 0 when CC is not connected.

PS0/HLED (PIN 15) of IP6537U can be multiplexed as intelligent power reduction control function or fast charging mode indication function; PIN 15 of IP6537U is multiplexed as intelligent power reduction control function by default. PIN 15 of IP6537U is multiplexed as fast charging mode indication function, IP6537U will control the output of PIN15 to indicate its working status according to whether it is in the fast charging output state or not.

Applied to dual-chip solution, PS1/PC1 (PIN 16) of IP6537U can be multiplexed as intelligent power reduction control function with PS0/HLED (PIN 15), to realize dual-port intelligent power-reduced solution 1/2/3.

The PIN15 of IP6537U needs to be connected with PIN15 of another IP6537U, and connected to ground through a resistor. PIN16 of the two IP6537Us also need to be connected in this way. IP6537U can detect the voltage of PIN15 and PIN16 to realize the function of adjusting the output power automatically.

Applied to a single-chip solution, PS1/PC1 (PIN 16) of IP6537U can be multiplexed as power selection control function with CCOK/PC0 (PIN 12), to realize the function of configuring its own output power according to the voltage on PIN 12 and PIN 16.

13 Application Notes

13.1 Input Capacitance Selection

The ESR of the input capacitor should be as small as possible. The ESR will affect the conversion efficiency of the system.

The maximum ripple current supported by the input capacitor must be greater than the maximum VIN ripple current of the system. The ripple current RMS value of the input capacitor is calculated as follows:

$$I_{RMS} = I_{LOAD} * \sqrt{\frac{V_{OUT}}{V_{IN}} * (1 - \frac{V_{OUT}}{V_{IN}})}$$

I_{LOAD} is the load current, V_{IN} is the input voltage, V_{OUT} is the output voltage.

13.2 Inductance Selection

The inductor with 22uH is recommended for most applications.

The DCR of inductor has a great influence on the conversion efficiency of the system, and low DCR inductors are recommended. For solutions above 30W, it is recommended to use an inductor with a DCR of less than 10mohm.

The inductor saturation current should be at least 20% greater than the system's peak inductor current limit to avoid inductor saturation, causing inductance drop and system instability.

The calculation formula of the PEAK current (IL(PEAK)) is as follows:

$$I_{L(PEAK)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

I_{LOAD} is the LOAD current, ΔI_L is the peak-to-peak value of the inductor current, The calculation formula of ΔI_L is as follows:

$$\Delta I_L = \frac{V_{OUT} * (V_{IN} - V_{OUT})}{V_{IN} * L * F_S}$$

V_{IN} is the input voltage, V_{OUT} is the output voltage, L is the inductance, F_S is the switching frequency.

13.3 Output Capacitance Selection

The output capacitance is used to keep the output stable. The value of ESR and capacitance has an impact on the output ripple. The output ripple voltage $V_{out-ripple}$ can be calculated as follows:

$$V_{out-ripple} = \Delta I_L * (R_{ESR} + \frac{1}{8 * F_S * C_{OUT}})$$

ΔI_L is the peak-to-peak value of the inductor current, R_{ESR} is the equivalent serial resistance value of the output capacitance, F_S is the switching frequency, C_{OUT} is the output capacitance value.

14 Typical Application Schematic

14.1 Single Type-C Port Application Solution

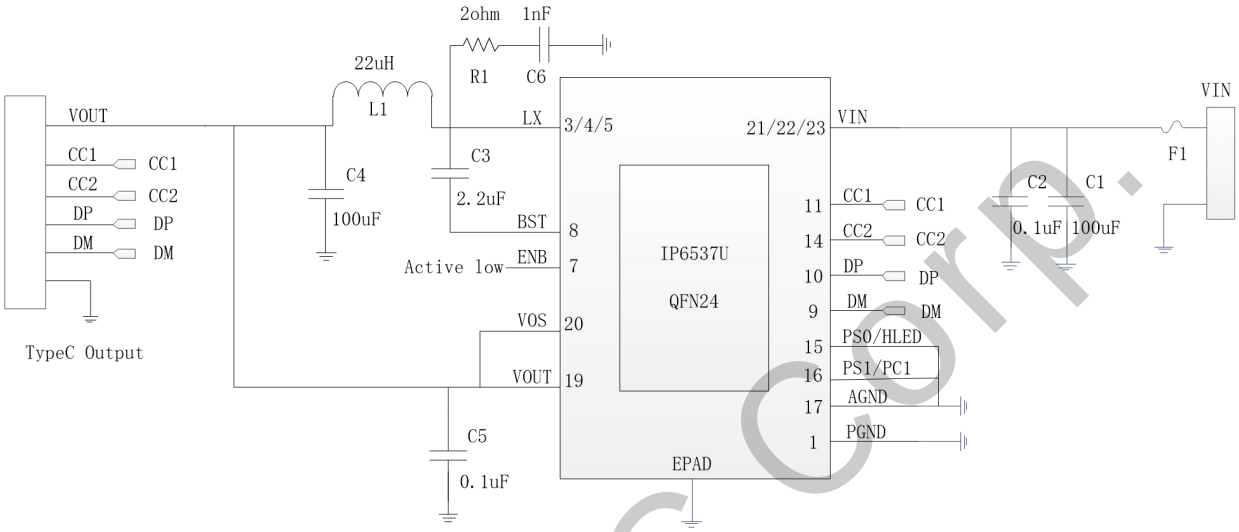


Fig. 7 IP6537U Application Schematic of Single Type-C Port PD Fast Charging Output

Note:

1. Applied to a single-chip solution, PS0/HLED(PIN15) and PS1/PC1 (PIN 16) of IP6537U shall be connected to ground.

2. ENB cannot be floating and needs to be given a definite level; the chip turns on when ENB is low and turns off when ENB is pulled up to 2V or more.

14.2 Dual-Port Intelligent Power-Down Solution

14.2.1 Power Distribution Table

IP6537U can communicate with another IP6537U through two resistors to realize various dual-port intelligent power-reduced solutions, with the characteristics of solution simplicity and application flexibility. The power distribution of each solution is as follows:

Solution	IC	Connected port	Output power		Note
			USB-C1	USB-C2	
Plan 1	IP6537U_1_35W _ 27W5_7W5	C1	35W	-	The power is distributed by whether the connected device is applying for PD fast charging.
		C2	-	35W	
		C1+C2	27.5W	7.5W	
		C1+C2	7.5W	27.5W	
		C1+C2	17.5W	17.5W	
		C1+C2	7.5W	7.5W	
Plan 2	IP6537U_2_35W _ 27W5_7W5	C1	35W	-	The power is distributed by whether the connected device is applying for PD or DP/DM fast charging.
		C2	-	35W	
		C1+C2	27.5W	7.5W	
		C1+C2	7.5W	27.5W	
		C1+C2	17.5W	17.5W	
		C1+C2	7.5W	7.5W	
Plan 3	IP6537U_3_35W _ 20W_15W	C1	35W	-	The power is distributed by the power level of the connected device is applying for.
		C2	-	35W	
		C1+C2	15W	20W	
		C1+C2	20W	15W	
		C1+C2	15W	15W	
Plan 4	IP6537U_4_35W _ 20W_15W	C1	35W	-	The power is distributed by the order of connected devices.
		C2	-	35W	
		C1+C2	15W	20W	
		C1+C2	20W	15W	
Plan 5	IP6537U_5_35W _ _20W	C1	35W	-	The power is distributed by the number of connected devices.
		C2	-	35W	
		C1+C2	20W	20W	

14.2.2 Application Schematic of Solution 1/2/3

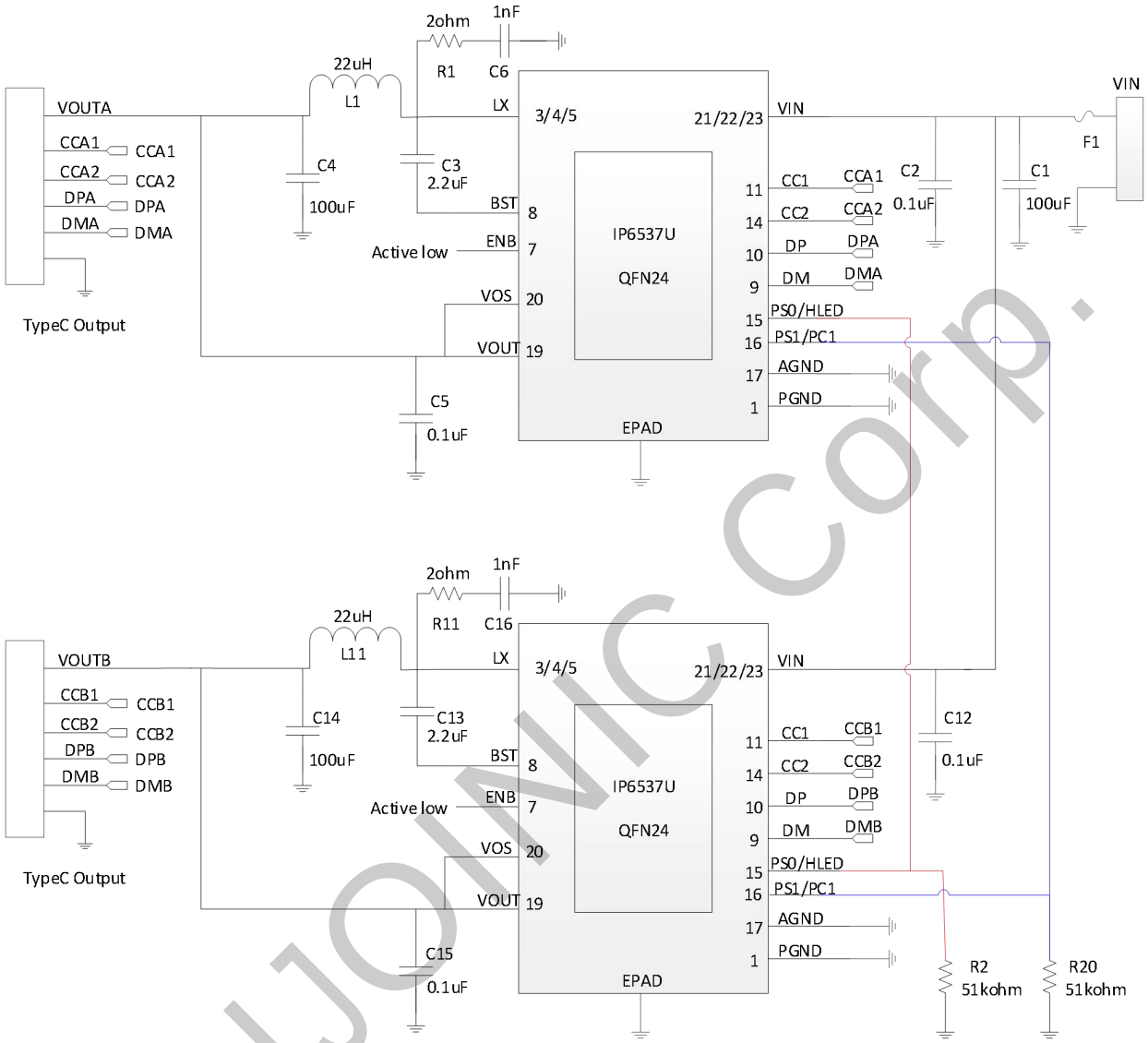


Fig. 8 IP6537U Application Schematic of Dual-Port Intelligent Power-Reduced Solution 1/2/3

Note of Dual-Port Intelligent Power-Reduced Solution 1/2/3:

1. The PIN15 of IP6537U shall be connected with PIN15 of another IP6537U, and connected to ground through a 51K resistor. PIN16 of the two IP6537Us also shall be connected in this way;
2. The PD output power in the dual-port intelligent power-reduced solution can be customized;
3. ENB cannot be floating and needs to be given a definite level; the chip turns on when ENB is low and turns off when ENB is pulled up to 2V or more;

14.2.3 Application Schematic of Solution 4/5

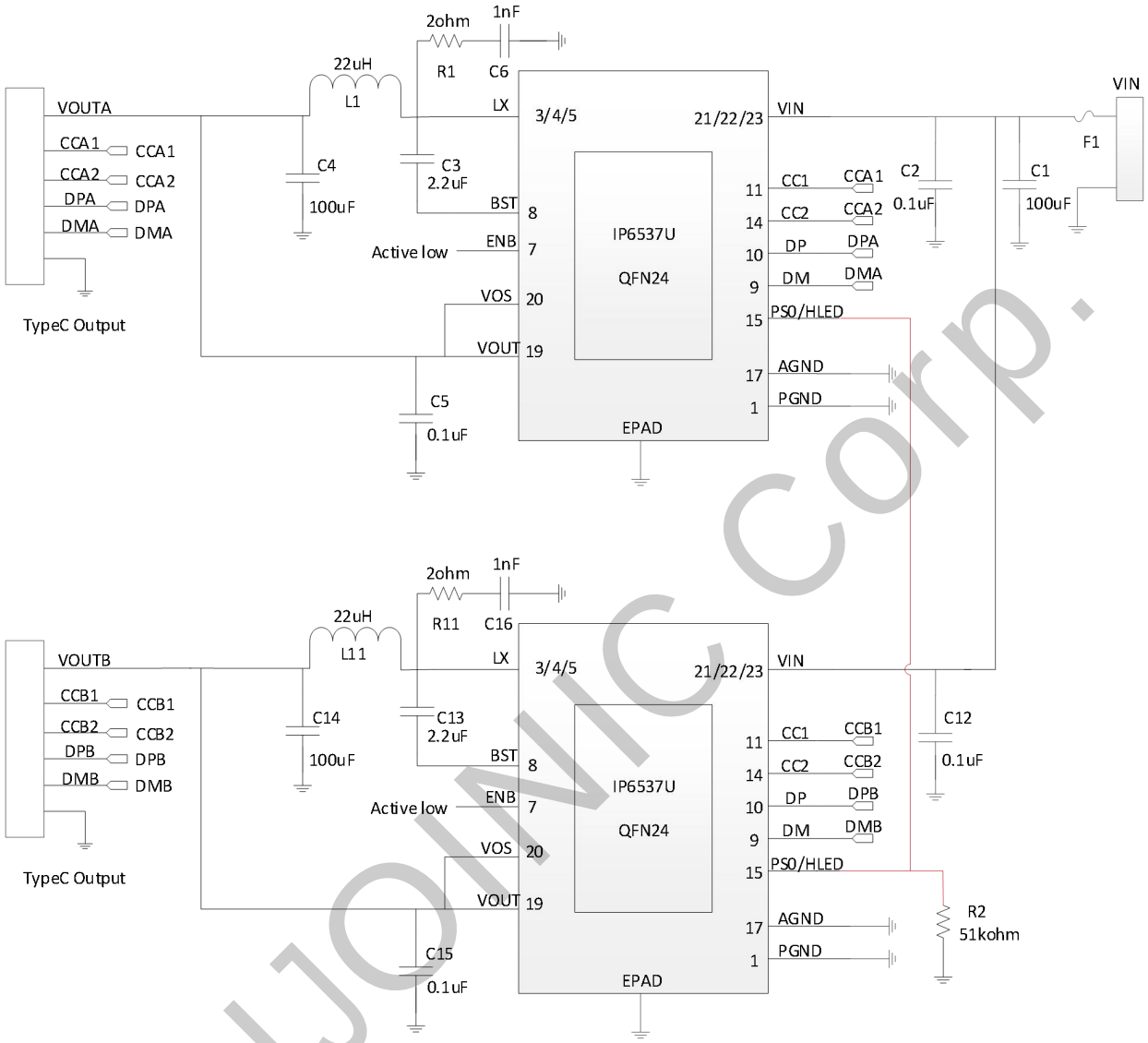


Fig. 9 IP6537U Application Schematic of Dual-Port Intelligent Power-Reduced Solution 4/5

Note of Dual-Port Intelligent Power-Reduced Solution 4/5:

1. The PIN15 of IP6537U shall be connected with PIN15 of another IP6537U, and connected to ground through a 51K resistor.
2. The PD output power in the dual-port intelligent power-reduced solution can be customized;
3. ENB cannot be floating and needs to be given a definite level; the chip turns on when ENB is low and turns off when ENB is pulled up to 2V or more;

15 BOM

Taking IP6537U application schematic of single Type-C port PD fast charging output as an example (Figure 7 on page 16), the collated BOM list is as follows:

NO.	Device	Spec.	Unit	Counts	Designator	Note
1	IC	IP6537U_C	PCS	1		
2	magnetic ring inductor	22uH+/-20%，Nominal current 5A DCR<12mohm	PCS	1	L1	
3	electrolytic capacitor	100uF/35V	PCS	1	C1	Rated voltage>35V
4	electrolytic capacitor	100uF/25V	PCS	1	C4	Rated voltage>25V
5	SMD capacitor	0603 100nF 10%	PCS	2	C2, C5	Rated voltage>35V
6	SMD capacitor	0603 2.2uF 10%	PCS	1	C3	Rated voltage>35V
7	SMD capacitor	0603 1nF 10%	PCS	1	C6	Rated voltage>35V
8	SMD resistor	0603 2R 5%	PCS	1	R1	
9	Fuse		PCS	1	F1	

16 Considerations for PCB Layout

IP6537U integrated buck converter, PCB layout is important for system stability, EMI, and other performance indicators, the IP6537U PCB layout suggestions are as follows:

1.The capacitor C2 on VIN should be close to the VIN pin of the IC, so that the loop area can be minimized at these points from VIN to PGND via the capacitor;

2. Capacitor C3 shall be placed close to the LX and BST of the IC;

3. The EPAD of IC pad needs to be windowed and punches plentiful enough overholes to ensure good contact between the EPAD with tin and the PGND of system during production;

4. The output feedback line to the VOUT PIN of chip needs to be far away from the LX line, and ground isolation should be used between the two lines.

5. The loop composed of RC circuit of LX, LX pin and PGND of IC shall be as small as possible on the PCB board;

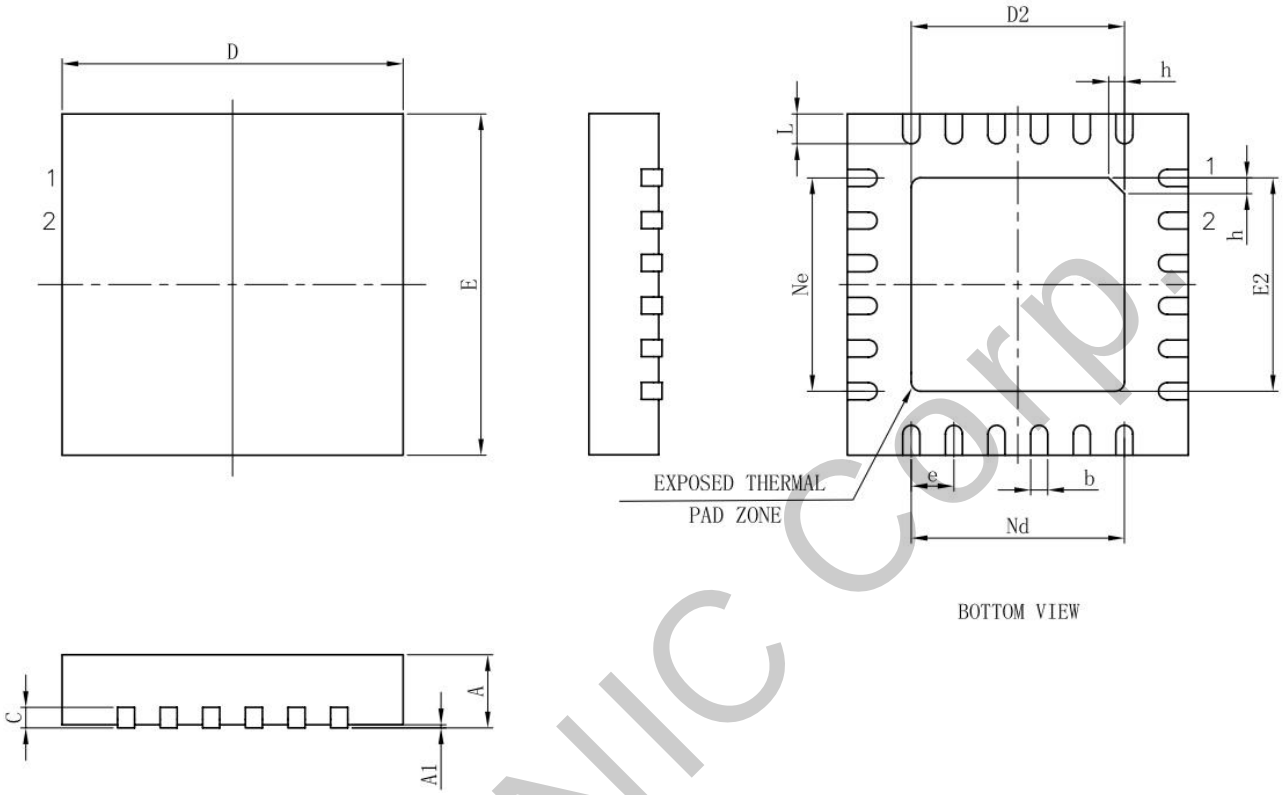
6. The GND of the input and output capacitors must be connected to the PGND of a large area;

7. When the program on the USB holder without DP/DM pins, the PCB shall reserve DP/ DM interface, to facilitate the device for subsequent upgrades.

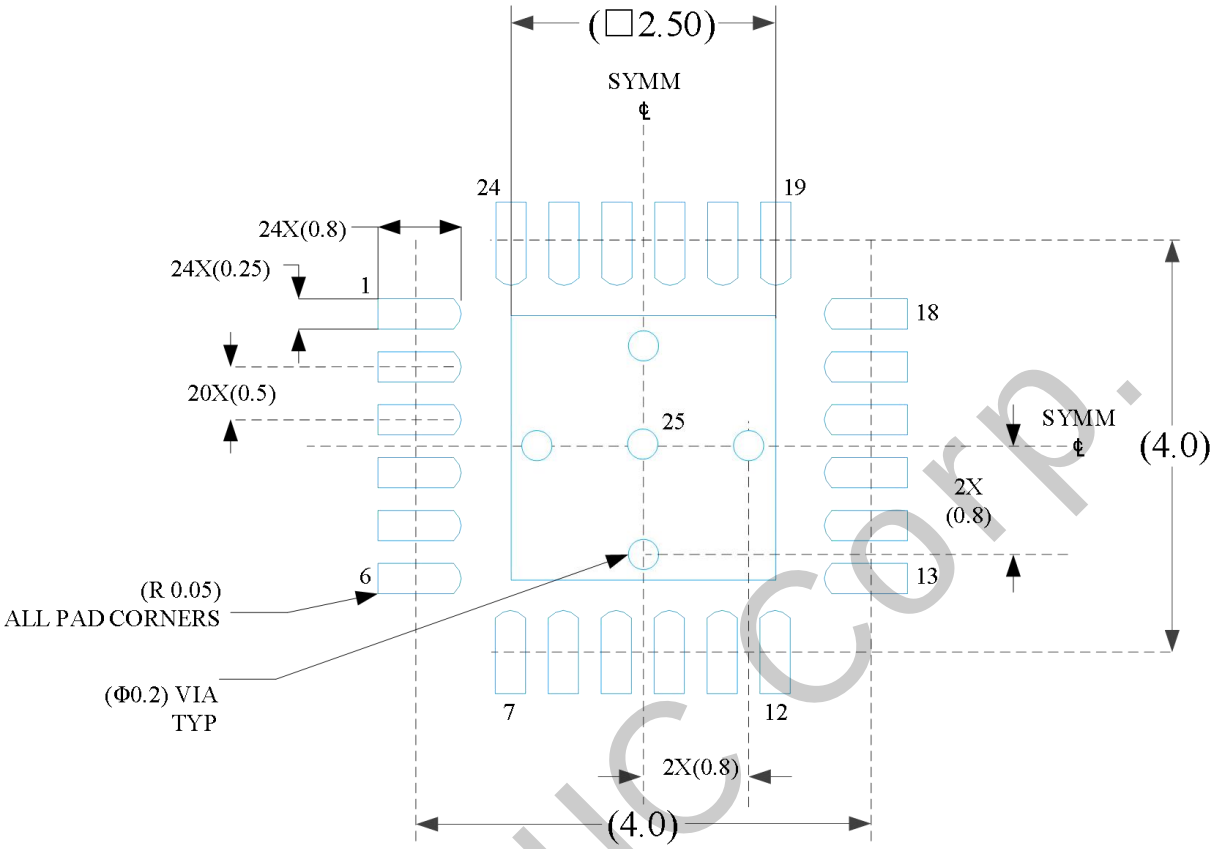
8. The following paths with high currents flowing through them should be thickened:

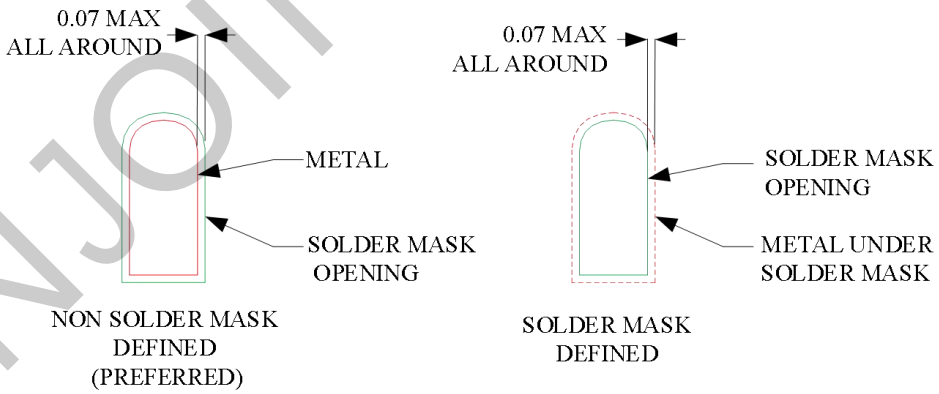
- The VIN of the input positive IC shall be copper-lined;
- the LX of the IC to the inductor L1 shall be copper-lined as short as possible;
- The output VOUT network shall be copper-lined;

17 Package

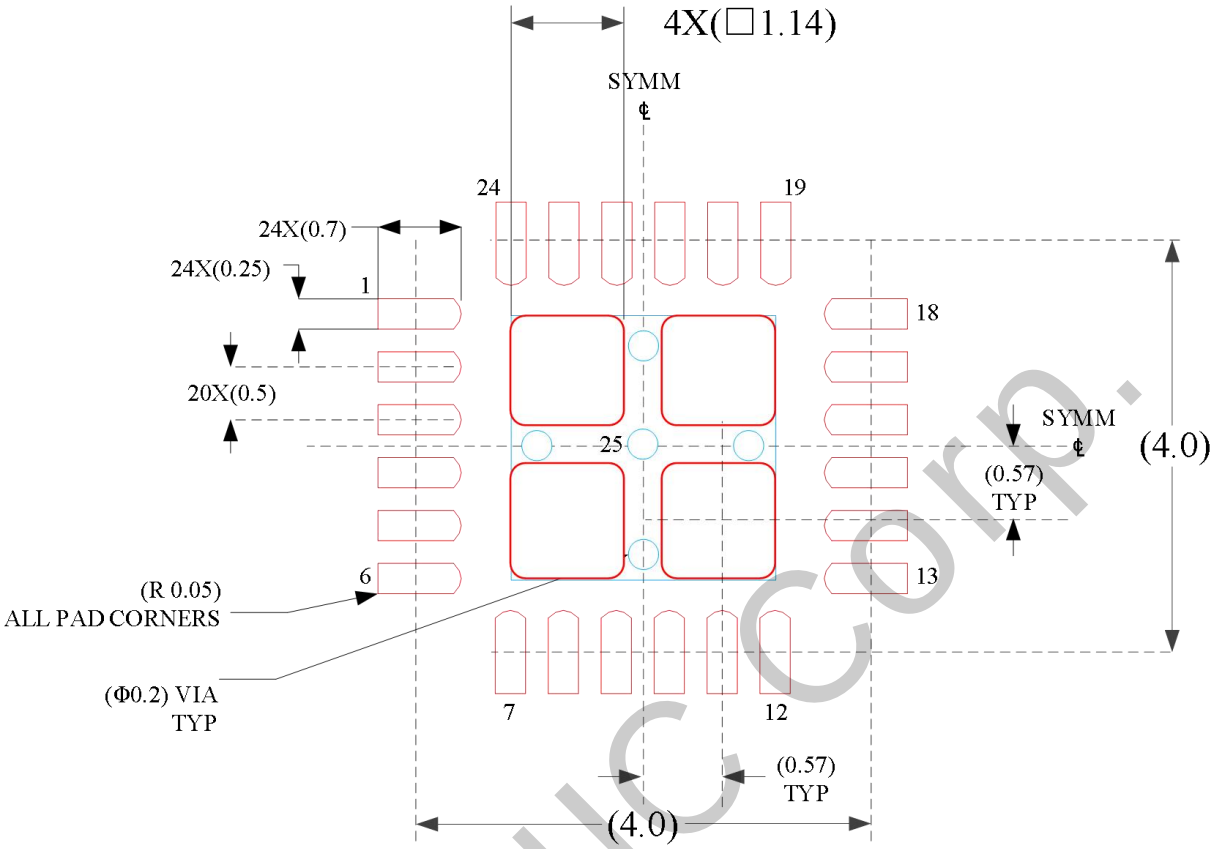


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	3.90	4.00	4.10
D2	2.40	2.50	2.60
e	0.50BSC		
Ne	2.50BSC		
Nd	2.50BSC		
E	3.90	4.00	4.10
E2	2.40	2.50	2.60
L	0.35	0.40	0.45
h	0.30	0.35	0.40





SOLDER MASK DETAILS

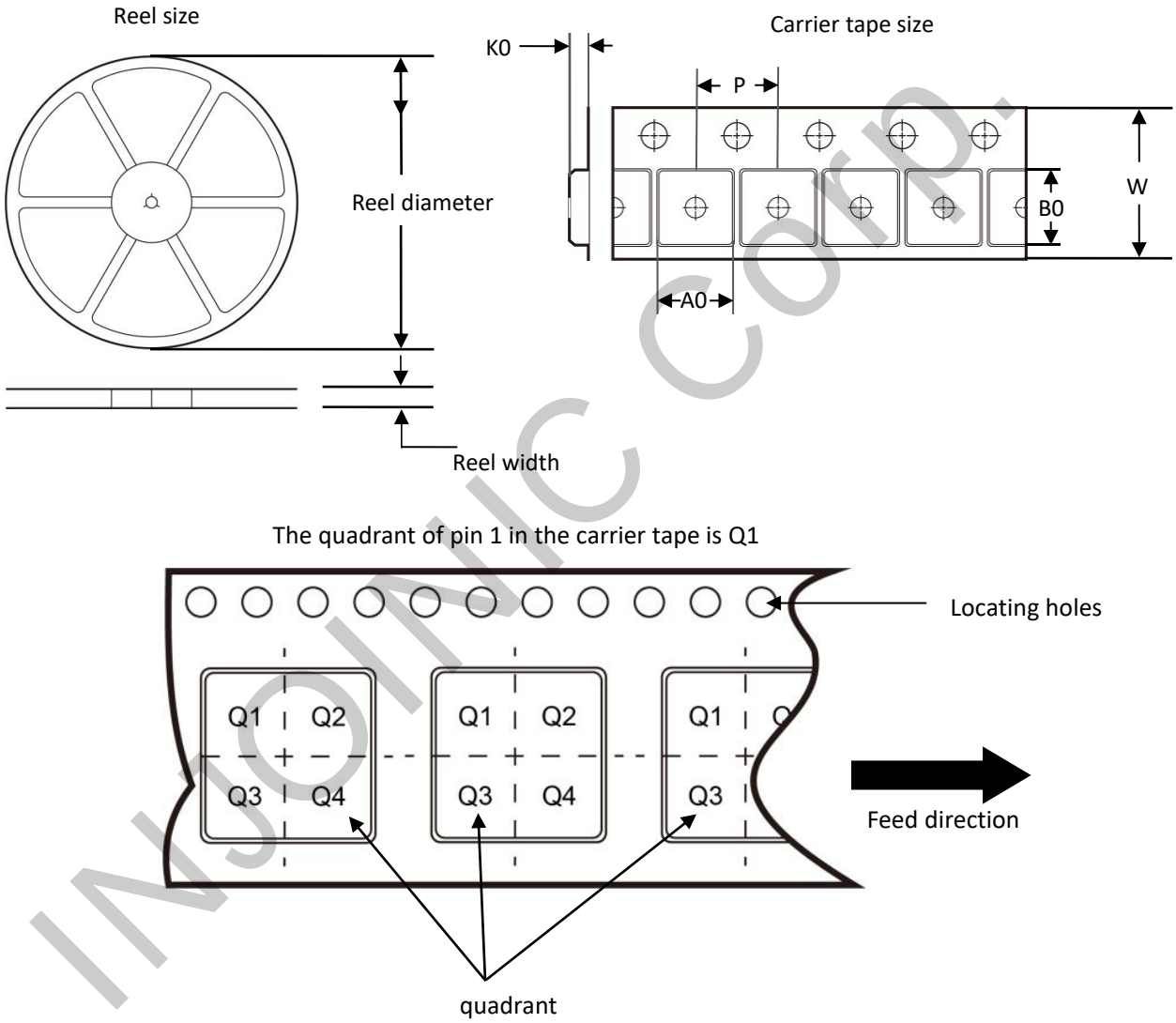


SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
80% PRINTED SOLDER COVERAGE BY AREA
SCALE: 20X

18 Tape and Packaging Information

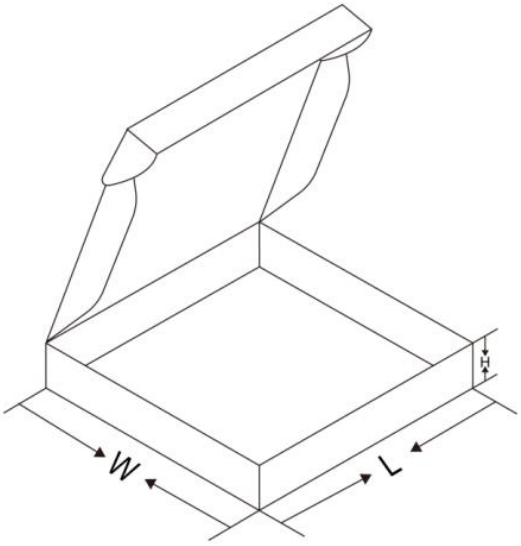
18.1 Tape Information



*All sizes are standard

IC model	Pkg	Pin num	standard quantity	Reels diameter (mm)	Reels Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P (mm)	W (mm)	Pin1 quadrant
IP6537U	QFN24	24	5000	330	12.5	4.45 ±0.10	4.50 ±0.10	1.2 ±0.10	8.0 ±0.1	12 ±0.3	Q1

18.2 Reel Packaging Carton Specifications



*All sizes are standard

Package form	Packaging method	Only/disc	Disc/inner box	Only/box	Inner box/carton	Only/carton	Inner box length（mm）	Inner box width（mm）	Inner box height（mm）
QFN24	Taping	5000	2	10000	6	60000	360	360	50

Carton size:385*345*380mm **Inner box size:360*360*50mm**

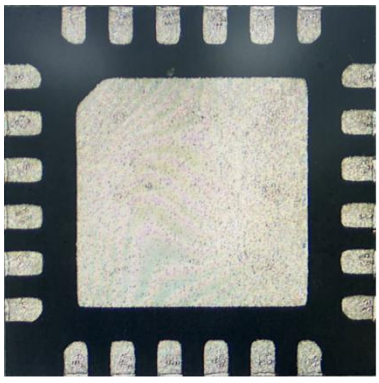
19 Silk Screen Information

说明：

1、ⓘ --INJOINIC LOGO
2、IP6537 --Product model
3、XXXXXXXX -Production lot number
4、● --PIN1 location identification

IP6537U Silk screen instructions

20 Photos of Physical Objects



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