

## SOC Output 45W Power with Type-C PD and Several Fast Charge Output Standards

Fast Charge Standards: DCP/QC2.0/QC3.0/PE+1.1/PE2.0/FCP/AFC/SFCP/SCP/ USB PD

### 1 Features

- **Synchronized Switch Regulator**
  - ◇ Built-in power MOSFET
  - ◇ Input voltage range: 10.5V~32V
  - ◇ Output voltage range: 3V~20V, adjust along with fast charge negotiation
  - ◇ Output power: up to 45W (3V@3.6A, 5V@3.4A, 9V@3A, 12V@3A, 15V@2.3A, 20V@2.3A)
  - ◇ Output voltage line compensate: 50mV/A
  - ◇ Output CV/CC characteristic: CV—output current lower than preset value; CC—output current higher than preset value
  - ◇ Conversion efficiency: up to 97%
  - ◇ Soft start function
- **Support Type-C output and USB PD protocol**
  - ◇ Support 5V, 9V, 12V, 15V, 20V PD output
- **Fast charge output**
  - ◇ Support BC1.2, Apple, Samsung
  - ◇ Support Qualcomm QC2.0, QC3.0 (Certificate No.: 4787930010-2)
  - ◇ Support MTK PE+1.1 and MTK PE+2.0
  - ◇ Support Huawei Fast charge: FCP and SCP
  - ◇ Support Samsung fast charge : AFC
  - ◇ Support Spreadtrum fast charge : SFCP
- **Multi-protection and high reliability**
  - ◇ Input overvoltage, input under voltage, output short circuit, output overcurrent protection
  - ◇ Whole system over temperature protection
  - ◇ ESD 4KV, DC voltage withstand 48V
- **Package: 4\*4mm QFN24**

### 2 Applications

- Car Charger
- Fast Charge Adaptor
- Smart Power Strip

### 3 Description

IP6518 is a synchronized switch buck regulator and support 13 fast charge output standards, support Type-C and PD output, providing solutions for car charger, fast charge adaptor and smart power strip.

IP6518 has built-in power MOSFET, input voltage range is 10.5V to 32V, output voltage ranges from 3V to 20V, and supply up to 45W output power; support voltage and current auto adjust according to the fast charge standard. Typical output voltage and current including: 3V@3.6A, 5V@3.4A, 7V@3A, 9V@3A, 12V@3A, 15V@2.3A, 20V@2.3A. Power conversion efficiency is up to 97%.

IP6518 support CV/CC output, 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 with a lower output voltage.

IP6518 output voltage support line compensate, the output voltage will be increased along with an increased current, providing compensation on the voltage drop introduced by the wire resistance.

IP6518 support soft start, providing resistibility on the large inrush current during circuit start up.

IP6518 support Type-C output and integrate several fast charge standards, CC1/CC2 or DP/DM support auto distinguish on the fast charge of the accessed devices, and IP6518 will adjust the output voltage and current according to the fast charge standard automatically. Supported fast charge standards including: DCP (Apple, Samsung and BC1.2), Qualcomm QC2.0/QC3.0, MTK PE+1.1/PE+2.0, Huawei FCP/SCP, Spreadtrum SFCP, USB PD.

IP6518 support multi-protection on input overvoltage and under voltage, output overcurrent, overvoltage, under voltage and short circuit.

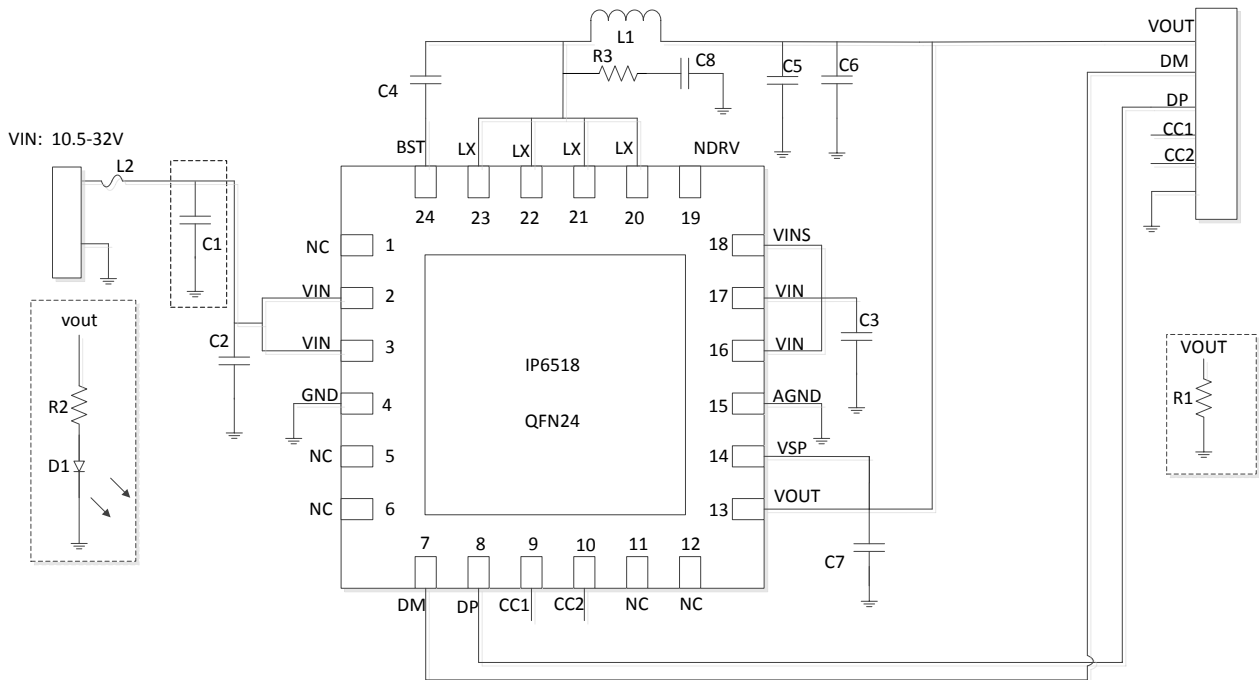


Figure 1 IP6518 simplified application schematic

## 4 Pin Definition

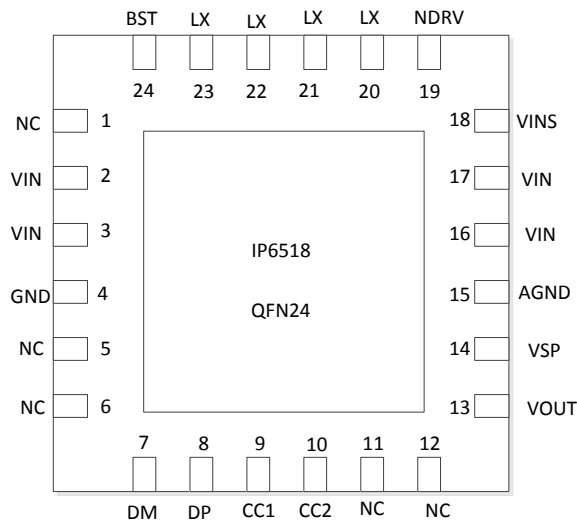


Figure 2 Pin Assignment

**PIN List:**

Pin		Description
No	Name	
1	NC	Float pin, do not connect
2, 3, 16, 17	VIN	Input voltage, place filter capacitor (22uF recommended) near this pin.
18	VINS	Input voltage detect pin, should connect to VIN
4	GND	Ground pin
5	NC	Float pin, do not connect
6	NC	Float pin, do not connect
7	DM	Connect to USB DM data line
8	DP	Connect to USB DP data line
9	CC1	Connect to USB Type-C CC1 line
10	CC2	Connect to USB Type-C CC2 line
11	NC	Float pin, do not connect
12	NC	Float pin, do not connect
13	VOUT	Output voltage feedback and output current limit detect pin, a 0.1uF capacitor near this pin is recommended
14	VSP	Output current limit detect pin, place a 0.1uF capacitor near this pin
15	AGND	Analog ground
19	NDRV	External NMOS gate control
20, 21, 22, 23	LX	DCDC switch node, connect to the inductor
24	BST	bootstrap circuit pin, place a 0.1uF capacitor close to the BST pin and LX pin, providing drive voltage for the gate of the upper MOSFET
25(EPAD)	GND	Power and heat dissipation ground

## 5 IC Selection Advice

IP6518 support PD 15V and 20V output, apply to smart power strip application, if PD 20V is needed, the input voltage should be 28V and larger than 1000uF capacitor should be applied to VOUT.

IP6518C support PD 12V, apply to car charger application.

	Input voltage	PD output voltage
IP6518	28V	5V/9V/12V/15V/20V
IP6518C	10~24V	5V/9V/12V

Pay attention to this difference between IP6518 and IP6518C before placing orders.

## 6 Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Input voltage	$V_{IN}$	-0.3 ~ 48	V
LX voltage	$V_{LX}$	-0.3 ~ $V_{IN}+0.3$	V
DM/DP/CC1/CC2 voltage	$V_{DM/DP/CC1/CC2}$	-0.3 ~ 6	V
VSP/VOOUT voltage	$V_{VSP/VSN}$	-0.3 ~ 28	V
Junction temperature	$T_J$	-40 ~ 150	°C
Storage temperature	$T_{stg}$	-60 ~ 150	°C
Thermal resistance (junction to ambient)	$\theta_{JA}$	40	°C/W
Human body model (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.

\*Voltages are referenced to GND unless otherwise noted.

## 7 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input voltage	$V_{IN}$	10.5	12/24	32	V

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

## 8 Electrical Characteristics

Unless otherwise specified,  $T_A=25^{\circ}\text{C}$ ,  $L=22\mu\text{H}$ ,  $V_{IN}=12\text{v}$ ,  $V_{out}=5\text{v}$

Parameter	Symbol	Test conditions	Min.	Typ.	Max.	Unit
<b>Input system</b>						
Input voltage	$V_{IN}$		10.5	12	32	V
Input under voltage threshold	$V_{IN-UV}$	Rising voltage		10.5		V
		Falling voltage		10.2		V
Input over voltage threshold	$V_{IN-OV}$	Rising voltage		34		V
		Falling voltage		32		V
Input quiescent current	$I_Q$	$V_{IN}=12\text{V}$ , $V_{OUT}=5\text{V}@0\text{A}$		2		mA
Standby current	$I_{standby}$	$V_{IN}=10\text{V}$		230		uA

Power switch system						
Upper MOSFET on resistance	$R_{DS(ON)}$			50		mΩ
Lower MOSFET on resistance	$R_{DS(ON)}$			40		mΩ
Switch frequency	$F_S$			200		KHz
Output system						
Output voltage	$V_{OUT}$		3	5	20	V
Output voltage ripple	$\Delta V_{OUT}$	VIN=12V, VOUT=5V@3A		120		mV
		VIN=12V, VOUT=9V@2A		120		mV
		VIN=24V, VOUT=12V@1.5A		120		mV
		VIN=28V, VOUT=20V@1.5A		200		mV
Soft start time	$T_{SS}$	VIN=12V, VOUT=5V		10		ms
Output line compensate voltage	$V_{COMP}$	VIN=12V, VOUT=5V, IOU=1A		50		mV
Max current of output CC mode	$I_{OUT}$	VIN=12V, VOUT<=4V		3.6		A
		VIN=12V, 4V<VOUT<=5V		3.4		A
		VIN=12V, 5V<VOUT<=7V		3		A
		VIN=12V, 7V<VOUT<=9V		3		A
		VIN=24V, 9V<VOUT<=12V		3		A
		VIN=28V, 12<VOUT<=20V		2.3		A
Output hiccup restart voltage	$V_{OUT}$	When output enters CC mode, output hiccup restart voltage		2.7		V
Thermal shutdown temperature	$T_{OTP}$	Rising temperature		140		°C
Thermal shutdown temperature hysteresis	$\Delta T_{OTP}$			40		°C

## 9 Function Description

### Synchronized switch buck regulator

IP6518 integrate a synchronized switch buck regulator, input voltage ranges from 10.5V to 32V and output from 3V to 20V, maximum output current if 4.5A. The frequency of the switch is 200kHz. When

VIN=12V, VOUT=5V@3A, the power conversion efficiency is 93.5%.

IP6518 can recognize the accessed fast charge standard and adjust the output voltage automatically.

IP6518 support soft start, in avoidance of the inrush current during start up, and the soft start time is 10ms.

When output voltage is 20V, VIN voltage should be above 28V.

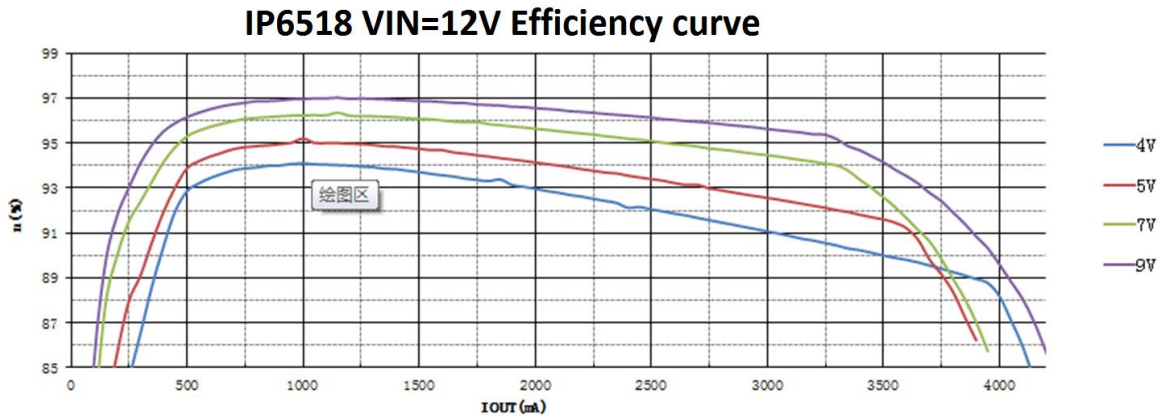


Figure 3 IP6518 Efficiency Curve

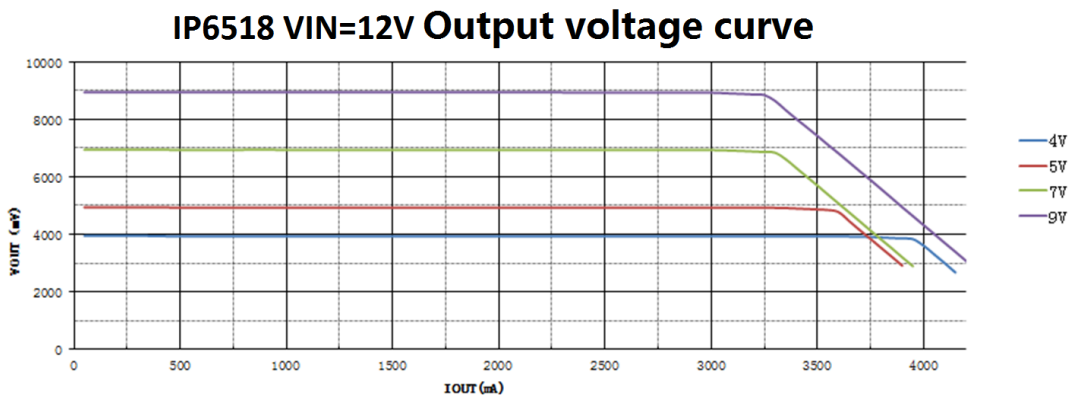


Figure 4 IP6518 VOUT-IOUT curve

## Output voltage line compensate

IP6518 support output line compensate, output voltage will increase 50mV as output current increase 1A.

## Output CV/CC characteristic

IP6518 support 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 with decreased output voltage; when the output voltage is lower than 2.7V, output will be shut down and restart with a 2s interval of hiccup.

## Protection

IP6518 detect the VIN voltage and enters standby mode when VIN is lower than 10.2V, the output will be shut down during standby mode.

IP6518 support input overvoltage protection; when VIN is above 34V, an overvoltage will be determined output will be shut down; IP6518 will reckon a normal working state and turn on the output only when VIN falls under 32V.

IP6518 support output under voltage protection; IP6518 will enter under voltage state when the VOUT is under 2.7V and shut down the output, after 2sec turn on the output with hiccup.

IP6518 support output short circuit protection, 4ms after start up, if VOUT is lower than 2.7V, output short circuit is determined and output will be shut down.

IP6518 support over temperature, when the chip temperature is higher than 140°C, the output will be shut down; IP6518 will reckon a normal working state and turn on the output only when the temperature falls under 100°C.

## Output fast charge standard

### IP65180 support several Fast charge output

- ◇ Support BC1.2, Apple, Samsung
- ◇ Support Qualcomm QC2.0, QC3.0
- ◇ Support MTK PE+1.1 and MTK PE+2.0
- ◇ Support Huawei Fast charge: FCP and SCP
- ◇ Support Samsung fast charge : AFC
- ◇ Support Spreadtrum fast charge : SFCP

## Type-C port and USB PD protocol

IP6518 support Type-C output and USB PD protocol, USB PD support output of : 5V/2.4A, 9V/2.4A, 12V/2.3A, 15V/2A, 20V2A.

IP6518 Type-C support several fast charge standards with DP/DM and CC1/CC2 pins, when IP6518 Type-C output 5V, other fast charge request will be accepted and voltage/current will be changed accordingly. But when IP6518 Type-C output non-5V voltage, other fast charge request will be ignored.

## 10 Typical Application Schematic

Just with inductor, capacitor and resistor peripherals, can IP6518 realize a total solution of car charger.

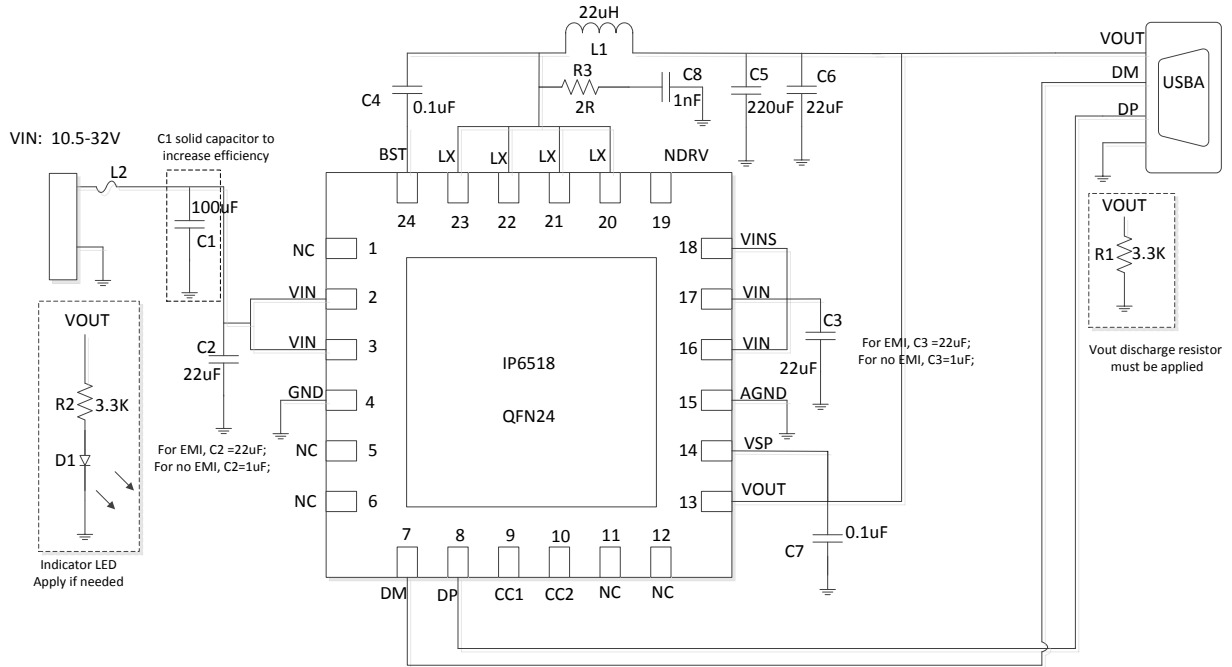


Figure 5 USB-A port output application schematic

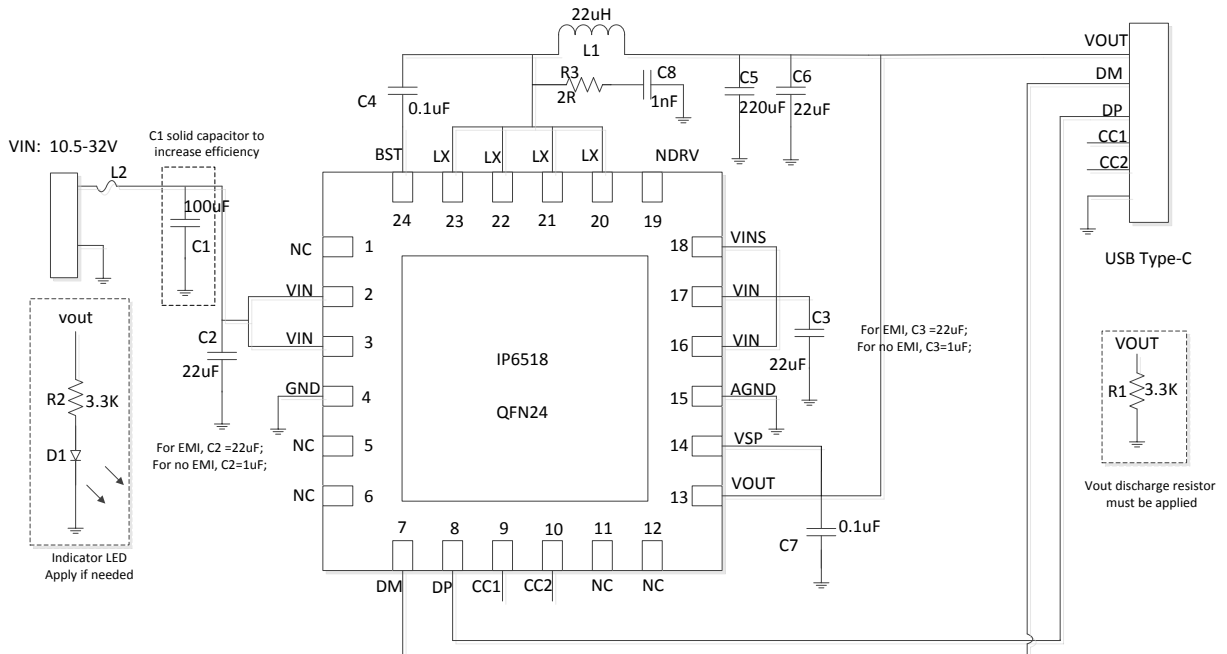


Figure 6 Type-C port PD fast charge output application schematic



## 11 BOM List

No.	Part Name	Type	Unit	Num.	Location	Note
1	IC	IP6518	PCS	1	U1	
2	SMT resistor	0603 3.3K 5%	PCS	1	R1、R2	R2 adjust indicator LED brightness
3	TC-220M-4.5A-CS137125	22uH+/-20%, current 4.5A DCR<12mohm	PCS	1	L1	3L Electronic
4	SMT capacitor	0603 1uF 10%	PCS	2	C2、C3	Withstand voltage higher than 25v, SMT ceramic capacitor is recommended; Place near IC pin in PCB layout; For EMI certificate, C5=C8=22uF, otherwise C5=C8=1uF;
5	SMT capacitor	0603 0.1uF 10%	PCS	3	C4、C7	Withstand voltage higher than 25V
6	SMT LED	0603	PCS	1	D1	
7	electrolytic capacitor	100uF/35V	PCS	1	C1	Withstand voltage higher than 35V To increase efficiency, C1 can be solid-state capacitor
8	electrolytic capacitor	220uF/25v	PCS	1	C5	Withstand voltage higher than 25V
9	SMT capacitor	0805 22uF 10%	PCS	1	C6	Withstand voltage higher than 25V
10	Fuse	L2	PCS	1	L2	Current value 4A
11	SMT resistor	0603 2R 5%	PCS	1	R3	
12	SMT capacitor	0603 1nF 10%	PCS	1	C8	Withstand voltage higher than 16V

Inductor type recommend:

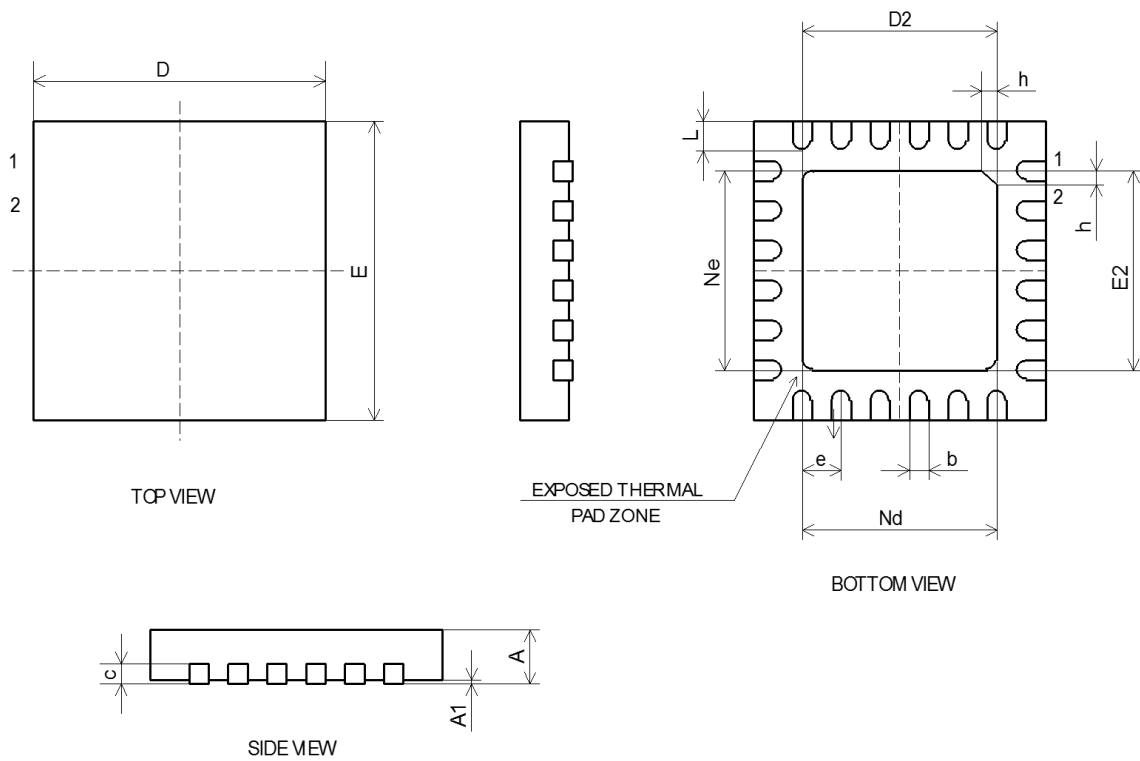
TC-220M-4.5A-CS137125

3L product No.	Inductance (uH)	Tolerance	DC Resistance (mΩ)		Heat Rating Current DC Amp.	Saturation Current DC Amps.	Measuring Condition
			Typ.	Max.	Idc(A)Max.	Isat(A)Max.	
TC-220M-4.5A-CS137125	22.0	±20%	12	14	4.5	8	

## 12 IP series IC Products List

IC Part	Charge/ Discharge	Dual ports	Protocols										Package	
			DCP	QC 2.0	QC 3.0	FCP	SCP	AFC	MTK PE	SFCP	PD 2.0	PD3.0 (PPS)	Pkg	P2P
IP6502	2.4A	-	√	-	-	-	-	-	-	-	-	-	SOP8	PIN2PIN
IP6503	3.1A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	
IP6503_2A4	2.4A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	
IP6503S	3.1A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP6503S_2A4	2.4A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	
IP6523S	3.4A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	
IP6505	24W	-	√	√	√	√	√	√	√	√	-	-	ESOP8	
IP6505T	24W	-	√	√	√	√	√	√	√	√	-	-	ESOP8	PIN2PIN
IP6525T	18W	-	√	√	√	√	-	√	-	-	-	-	ESOP8	
IP6510	18W	-	√	√	√	√	-	√	-	-	√	-	ESOP8	
IP6518C	36W	-	√	√	√	√	√	√	√	√	√	-	QFN24	PIN2PIN
IP6518	45W	-	√	√	√	√	√	√	√	√	√	-	QFN24	
IP6515	4.8A	√	√	-	-	-	-	-	-	-	-	-	QFN32	
IP6528_CC	27W	√	√	√	√	√	√	√	√	-	√	√	QFN32	PIN2PIN
IP6528_AC	27W	√	√	√	√	√	√	√	√	-	√	√	QFN32	
IP6528_AA	24W	√	√	√	√	√	-	√	√	-	-	-	QFN32	

## 13 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

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