IP6515

Dual Ports Output 5V/4.8A Buck Converter with Dual DCP Protocol

1 Features

- **Synchronous-rectified buck converter**
  - ✧ Built-in power MOSFET
  - ✧ Input voltage range: 8.2V~32V
  - ✧ Single port output power: 5V/2.4A
  - ✧ Dual port output power: 5V/4.8A
  - ✧ IP6515 Output voltage has line compensate function of 50mV/A
  - ✧ Support CV/CC output mode: CV mode (output current < preset value); CC mode (output current > preset value)
  - ✧ conversion efficiency up to 95.6% with VIN=12V, dual ports output 5V/4.8A
- **Fast charge output**
  - ✧ Support 2 ports of BC1.2, Apple, Samsung
- **Multi protection and high reliability**
  - ✧ Support input over voltage and under voltage protection, support output short circuit, over current and over temperature protection
  - ✧ DP/DM over voltage protection
  - ✧ DP/DM withstand voltage of 30V
  - ✧ ESD 4KV, DC withstand voltage of 40V
- **Package: 5*5mm QFN32**

2 Application

- Car charger
- Fast charge adaptor
- Smart power strip

3 Description

IP6515 is a Synchronous-Rectified Buck Converter which supports DCP output standards with dual USB A output ports. It provides solutions for car charger, fast charge adaptor and smart power strip.

IP6515 supports dual USB A output ports, any single port output power is 5V/2.4A. When dual ports have attached devices, overall output power is 5V/4.8A.

IP6515 has built-in power MOSFET, input voltage range is 4.5V to 32V, output voltage ranges from 3V to 12V with up to 45W power supply. IP6515 has a conversion efficiency of up to 95.6% when dual port output power 5V/4.8A.

IP6515 output has CV/CC mode, when the output current is lower than preset value, the output voltage will be constant in CV output mode; when the output current is higher than preset value, the output voltage will decrease in CC output mode.

IP6515 supports output line compensation, when output current increases, the output voltage will increase accordingly that makes up the resistive voltage drop introduced by connection, wire, and PCB traces.

IP6515 supports soft start function that protects the input power source from inrush current at start up.

4 Ip6515 Series Product Introduction

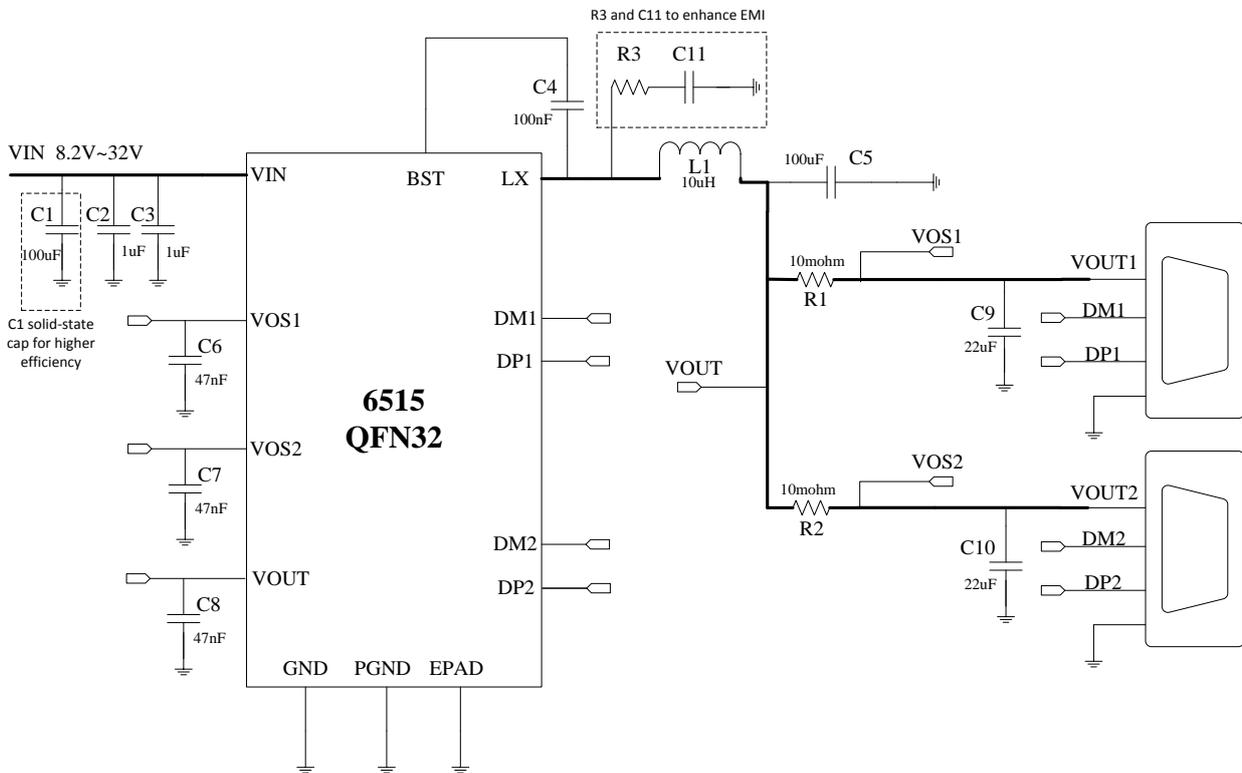| Product	Introduction
IP6515	Dual Ports Output 5V/4.8A with Dual DCP Protocol.
IP6515_OF	High efficiency converter with external feedback.

Figure 1. IP6515 dual USB A output ports simplified application schematic diagram

IP6515 layout notes:

1. C2 should be placed close to the PIN14/PIN15;

2. C3 should be placed close to the PIN26/PIN27;

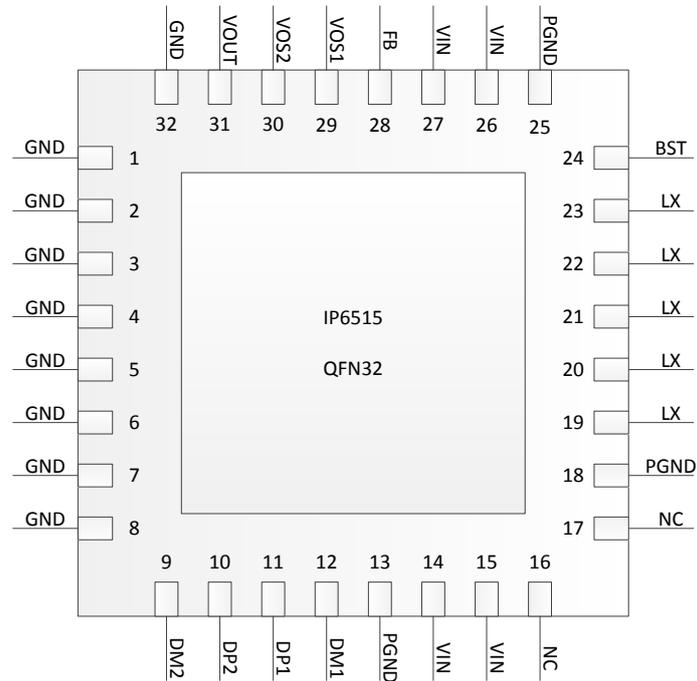3. C6, C7, and C8 should be placed close to the PIN;

5 Pin Functions

Figure 2. Pin functions

Pins		Description
Pin No.	**Pin Name**	
1/2/3/4/16/17/32	NC	Floating PIN, do not connect
5/6/7/8/13	GND	Ground
9	DM2	VOUT2 DM
10	DP2	VOUT2 DP
11	DP1	VOUT1 DP
12	DM1	VOUT1 DM
14/15/26/27	VIN	Power input
18/25	PGND	Power ground
19/20/21/22/23	LX	DCDC switch point, connect to inductor
24	BST	Connect to bootstrap capacitor
28	FB	External feedback pin
29	VOS1	VOUT1 output current negative sense pin
30	VOS2	VOUT2 output current negative sense pin
31	VOUT	VOUT1/VOUT2 output current positive sense pin
33	EPAD	Ground

6 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**
DM1/DP2 Voltage Range	$V_{DM1/DP1/DM2/DP2}$	-0.3 ~ 30	**V**
Junction Temperature Range	T_J	-40 ~ 150	℃
Storage Temperature Range	Tstg	-60 ~ 150	℃
Package Thermal Resistance	θ_{JA}	40	℃/**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

Parameters	Symbol	Min.	Typ.	Max	Unit
Input Voltage	V_{IN}	8.2	12/24	32	V

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

8 Electrical Characteristics

Unless otherwise specified, TA =25℃, L=22uH, VIN=12V, VOUT=5V

Parameters	Symbol	Test Condition	Min.	Typ.	Max	Unit
Input system						
Input voltage	V_{IN}		8.2	12	32	V
Input under voltage	V_{IN-UV}	Rising voltage	8.1	8.2	8.4	V
		Falling voltage	7.8	7.9	8	V
Input over voltage	V_{IN-OV}	Rising voltage	32.7	32.8	33	V
		Falling voltage	32	32.4	32.5	V
Input quiescent current	I_Q	VIN=12V, VOUT=5V/0A	--	3	--	mA
Power system						
High-side MOS Ron resistance	$R_{DS(ON)}$		--	10	--	mΩ
Low-side MOS Ron resistance	$R_{DS(ON)}$		--	9	--	mΩ
Switching frequency	F_S		135	150	160	KHz
Output system						

Output voltage	V_{OUT}		3	5	12	V
Output voltage ripple	ΔV_{OUT}	VIN=12V, VOUT=5V/4.8A COUT: 100uf solid-state cap	70	80	90	mV
Soft start time	T_{SS}	VIN=12V, VOUT=5V	--	5	--	ms
Output line compensate voltage	VCOMP	VIN=12V, VOUT=5V, IOUT=1A	--	50	--	mV
Output current in CC mode	IOUT	Single port output	--	2.4	--	A
		Dual ports output	--	4.8	--	A
Output hiccup restart voltage	VOUT	Hiccup restart voltage when output enter CC mode	--	3.6	--	V
Output overvoltage threshold	V_{OVP}	VOUT=5V	5.5	5.8	6.3	V
Thermal shutdown temperature	TOTP	Rising temperature	--	155	--	℃
Thermal shutdown temperature hysteresis	ΔT_{OTP}		--	45	--	℃

9 Function Description

Synchronous-Rectified Buck Converter

IP6515 integrate a Synchronous-Rectified Buck Converter, input voltage range is 8.2V~32V, output voltage 5V, dual port output current is 4.8A.

IP6515 integrate power switch MOSFET with 150kHz working frequency.

The conversion efficiency is 95.6% at VIN=12V, VOUT=5V/4.8A. The conversion efficiency is 94.7% at VIN=24V, VOUT=5V/4.8A.

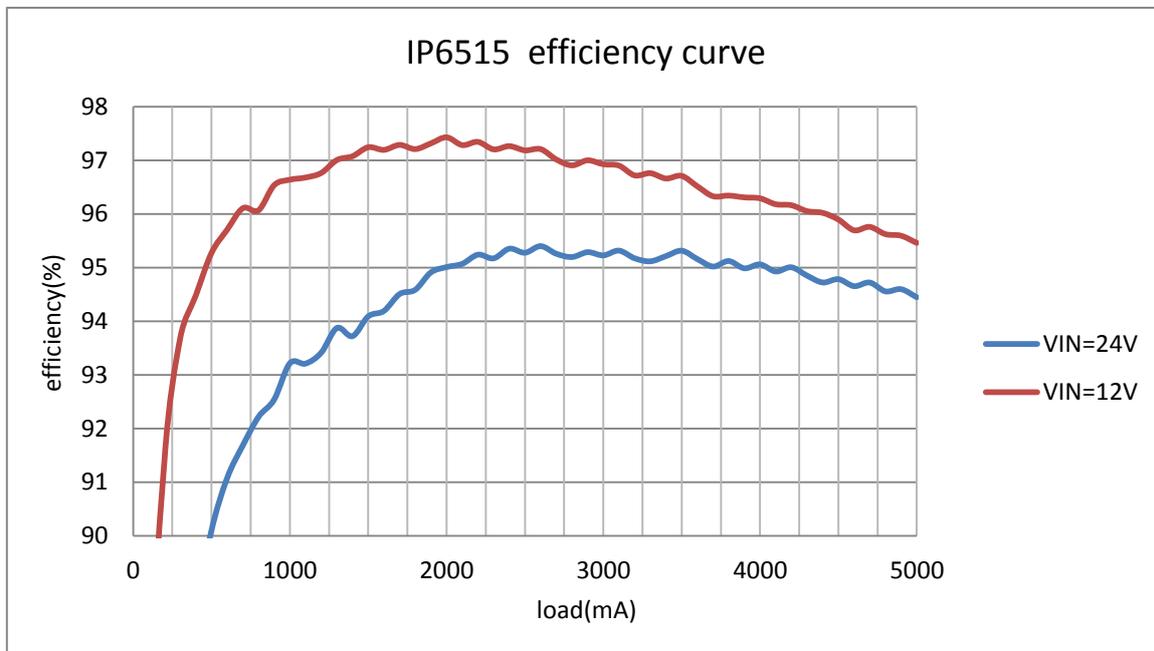IP6515 has soft start function, preventing the huge inrush current cause damage to the IC.
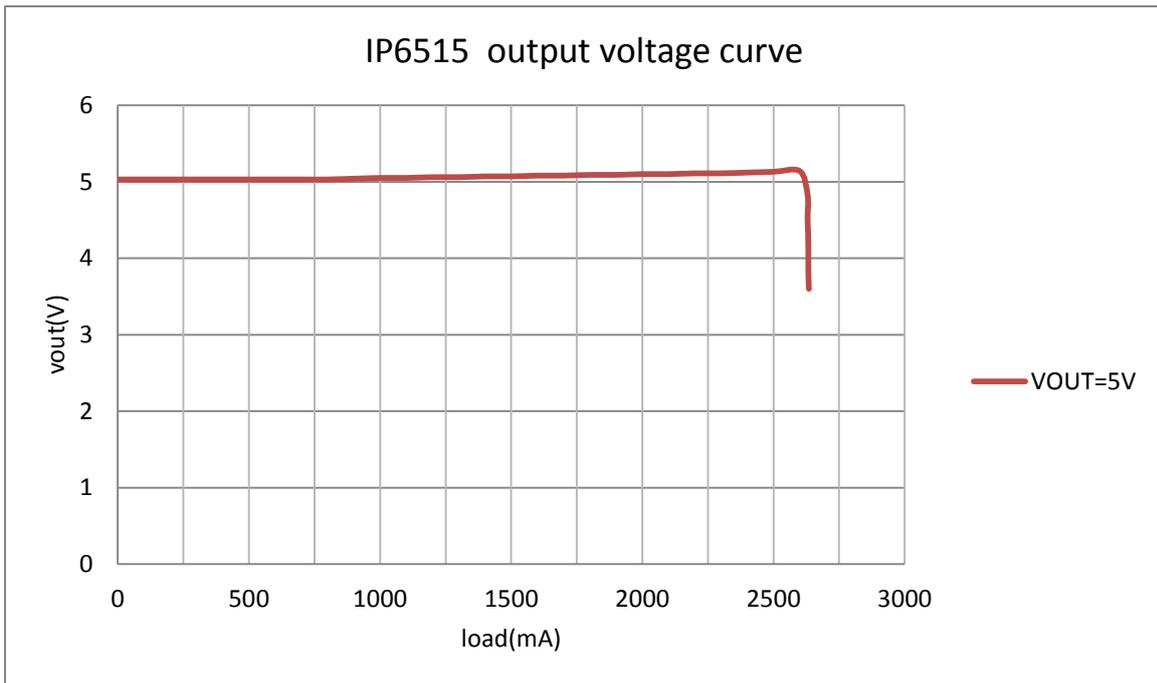
Figure 3. IP6515 output efficiency curve

Figure 4. IP6515 output voltage curve

Output Voltage Line Compensation Function

IP6515 output support line compensation function: the output voltage will increase 50mV as output current increase 1A.

IP6515_OF output voltage doesn't support line compensation function.

Output CC/CV Character

IP6515 output has CV/CC mode: when the output current is lower than preset value, the output is in CV mode with constant voltage; when the output current is higher than preset value, the output is in CC mode with decreasing output voltage.

the output voltage is lower than 3.6V, the output will be shut down and hiccup restart after 2sec.

Output CC Current Set

IP6515 VOUT1 output current limit can be adjusted by regulate the 10mOhm sensing resistor between VOUT and VOS1. VOUT2 output current limit can be adjusted by regulate the 10mOhm sensing resistor between VOUT and VOS2. The load current is measured by detect the voltage drop between VOUT and VOS.
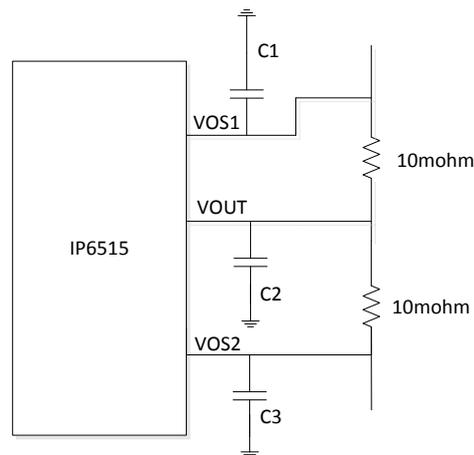
When the value of 10mohm current detect resistor is changed, the current limit of VOUT1 and VOUT2 will change accordingly.

In PCB layout, pay attention to the trace routing of VOS1/VOS2 and VOUT, the trace should go out directly from the two side of 10mOhm resistor, avoiding introduce current limit deviation because of additional PCB trace resistor. Other than that, the 10mOhm resistor should use alloy resistor with good temperature coefficient (100ppm) and high precision of 1%.

When current sampling resistor is 10mohm, IP6515 overcurrent protection value is 2.6A. IP6515 overcurrent protection value can be changed through adjusting current sampling resistor value. As shown below.

$$I_{OCP} = 0.026/R$$

R means current sampling resistor value.

If R increases to 20mohm from 10mohm, the overcurrent protection value will change to 1.3A.

Protection Function

IP6515 will detect the VIN voltage, if VIN voltage is lower than 7.9V, IP6515 will enter standby mode and shut down the output.

IP6515 support input over voltage protection: when the VIN voltage is higher than 32.8V, IP6515 determines the VIN is over voltage and shutdown the output; when VIN decrease under 32.4V, IP6515 determines the input voltage recovers and opens the output.

IP6515 support output under voltage protection: if the VOUT voltage is lower than 3.6V, IP6515 determines the output is under voltage and will shut down the output and hiccup restart after 2sec.

IP6515 support short circuit protect, 4ms after the circuit is started, if VOUT voltage is under 3.6V, IP6515 determines the output is short circuit and will shut down the output and hiccup restart after 2sec.

IP6515 support DP/DM over voltage protection, when the DP1/DM1/DP2/DM2 voltage is higher than 4.8V, IP6515 determines the signals are over voltage and will shut down the output and hiccup restart after 2sec.

IP6515 support over temperature protection: when the temperature detected is higher than 155℃, the output will be shut down. When the temperature decreases below 110℃, IP6515 determines the temperature has recovered and will restart the output.

When the junction temperature is high, the output voltage and current will be adjusted automatically by IP6515 to keep the constant temperature of the junction temperature.

Dual Fast Charge Output Ports

IP6515 support two USB A output ports, single port output power is 5V/2.4A.

When dual ports have attached device, dual ports overall output power is 5V/4.8A and single port maximum output power is 5V/2.6A.

IP6515_OF FB function

Attached protocol chip can adjust IP6515_OF output voltage by pulling current from FB pin.

Based on the circuit diagram shown in Figure 6，IP6515_OF output voltage will increase 0.2V if protocol chip is pulling 2uA current from FB pin. The calculation process of changed voltage is as follows:$100kohm * 2uA = 0.2V$.

10 Typical Application Schematic Diagram

IP6515 car charging solution only needs inductor, capacitor and resistor.

Figure 5. IP6515 dual USB A output ports application schematic diagram

IP6515 layout notes:

1. C2 should be placed close to the PIN14/PIN15;

2. C3 should be placed close to the PIN26/PIN27;

3. C6, C7, and C8 should be placed close to the PIN;

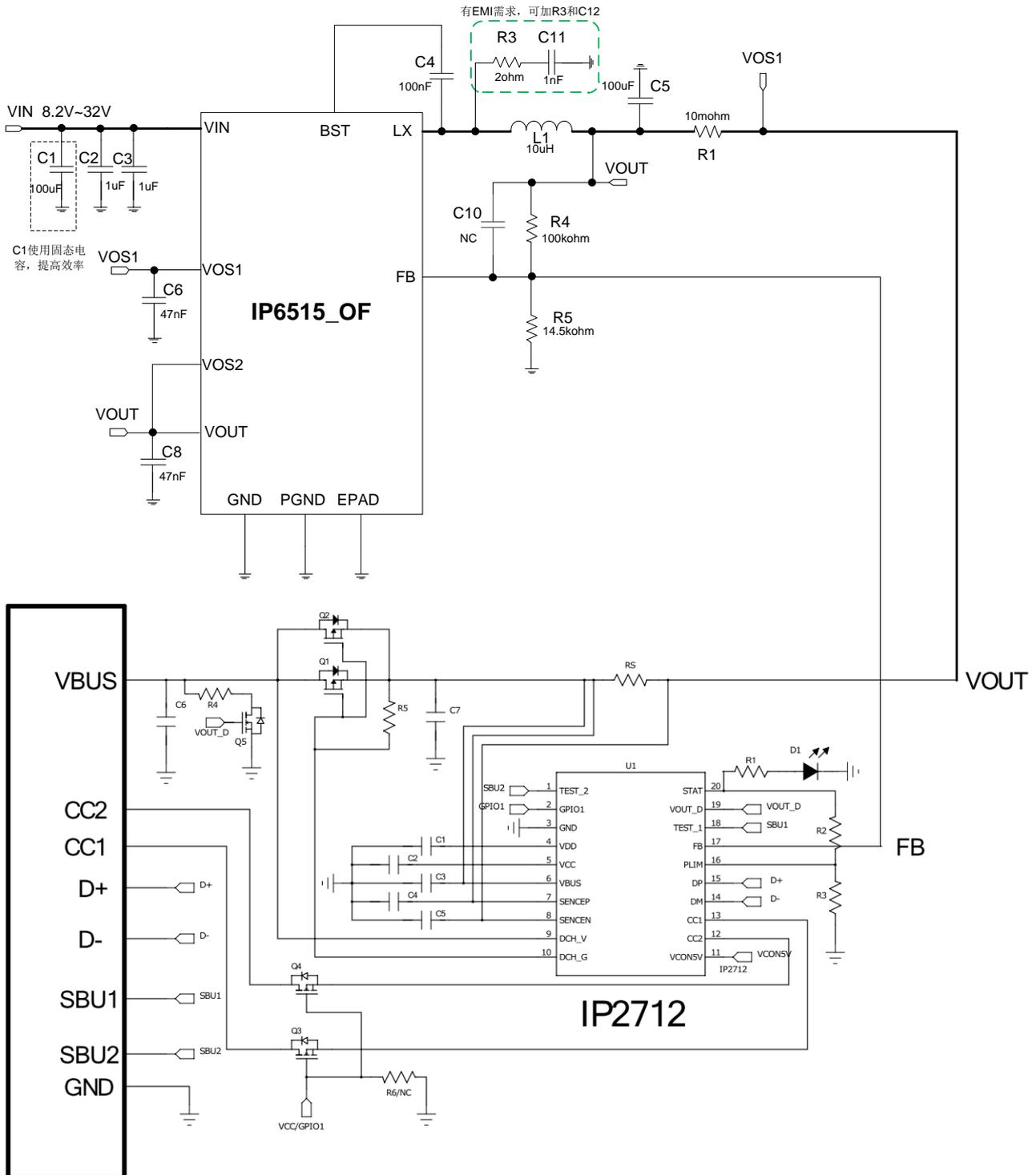Figure 6. IP6515_OF output application schematic diagram with IP2188

Figure 7. IP6515_OF output application schematic diagram with IP2712

IP6515_OF layout notes:

1. C2 should be placed close to the PIN14/PIN15;

2. C3 should be placed close to the PIN26/PIN27;

3. C6 and C8 should be placed close to the PIN;

11 BOM List

IP6515 BOM list:

| No.	Part Name	Type	Unit	Qty	Location	Notes
1	IC	IP6515	PCS	1		
2	TC-220M-4.5A-CS137125	10uH+/-20%, current 5A DCR<12mohm	PCS	1	L1	3L Electronic
3	SMD capacitor	0603　1uF 10%	PCS	2	C2, C3	Withstand voltage higher than 35V
4	SMD capacitor	0603　0.1uF 10%	PCS	1	C4	Withstand voltage higher than 10V
5	Electrolytic capacitor	100uF	PCS	1	C1	Withstand voltage higher than 35V Use solid-state capacitor will increase efficiency
6	Solid-state capacitor	100uF	PCS	1	C5	Withstand voltage higher than 6.3V
7	SMD capacitor	0603　47nF 10%	PCS	3	C6,C7,C8	Withstand voltage higher than 10V
8	SMD capacitor	0805　22uF 10%	PCS	2	C9, C10	Withstand voltage higher than 25V
9	SMD resistor	0603 2R 5%	PCS	1	R3	Enhance EMI
10	SMD capacitor	0603　1nF, 16V 10%	PCS	1	C11	Enhance EMI
11	SMD resistor	1206　10mohm 1% precision, temperature coefficient less than 100ppm	PCS	2	R1, R2	Current sense resistor

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	PIN2PIN
IP6503_2A4	2.4A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP6503S	3.1A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP6503S_2A4	2.4A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP6523S_N	3.4A	-	√	-	-	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP6505	24W	-	√	√	√	√	√	√	√	√	-	-	ESOP8	
IP6505T	24W	-	√	√	√	√	√	√	√	√	-	-	ESOP8	PIN2PIN
IP6525T_N	18W	-	√	√	√	√	-	√	-	-	-	-	ESOP8	PIN2PIN
IP6510	18W	-	√	√	√	√	-	√	-	-	√	-	ESOP8	
IP6518C	36W	-	√	√	√	√	√	√	√	√	√	-	QFN24	PIN2PIN
IP6518	45W	-	√	√	√	√	√	√	√	√	√	-	QFN24	PIN2PIN
IP6515	4.8A	√	√	-	-	-	-	-	-	-	-	-	QFN32	
IP6538_CC	27W	√	√	√	√	√	-	√	√	-	√	√	QFN32	PIN2PIN
IP6538_AC	27W	√	√	√	√	√	-	√	√	-	√	√	QFN32	PIN2PIN
IP6538_AA	24W	√	√	√	√	√	-	√	√	-	-	-	QFN32	PIN2PIN
IP6527_A	24W	-	√	√	√	√	√	√	√	-	-	-	QFN32	PIN2PIN
IP6527_C	27W	-	√	√	√	√	-	√	√	-	√	-	QFN32	PIN2PIN

13 Package
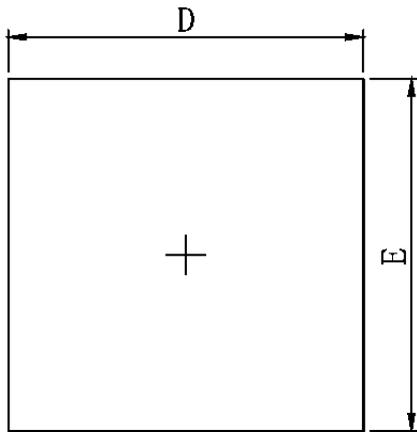
TOP VIEW
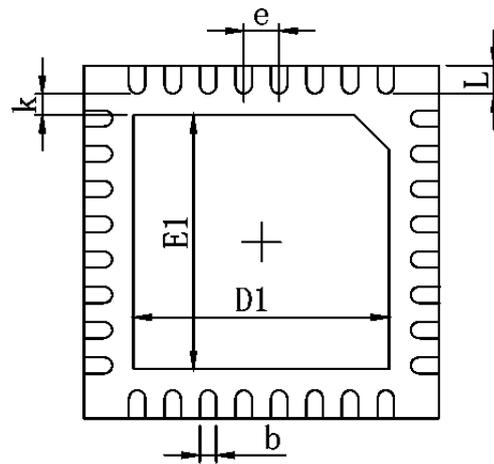
BOTTOM VIEW
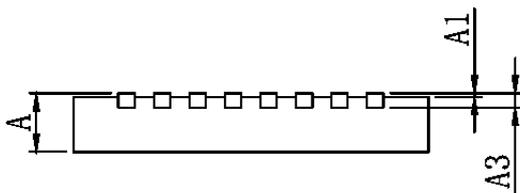
SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	4.924	5.076	0.194	0.200
E	4.924	5.076	0.194	0.200
D1	3.300	3.500	0.130	0.138
E1	3.300	3.500	0.130	0.138
k	0.200MIN.		0.008MIN.	
b	0.200	0.300	0.008	0.012
e	0.500TYP.		0.020TYP.	
L	0.324	0.476	0.013	0.019

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