

## Wireless Power Transmitter Compliant with WPC V1.2.4 protocol of 7.5W/10W

### Features

- Compliant with the WPC V1.2.4 specifications transmitter design
- Support 5~10W applications
  - ◇ Single 5W applications
  - ◇ Fast charge input for 5~10W applications
  - ◇ 5V DC input for step-up of 5~10W output applications
  - ◇ 9~15V DC input for step-down of 5~10W output applications
- Input withstand voltage up to 25V
- Integrate NMOS full bridge driver
- Integrate voltage/current demodulator
- Support FOD (Foreign Object Detection) function
  - ◇ High sensitivity
  - ◇ Support dynamic FOD
  - ◇ Adjustable FOD parameters
- Low quiescent dissipation and high efficiency
  - ◇ 4mA quiescent current
  - ◇ Charging efficiency is up to 79%
- Compatible with NPO and CBB capacitors
- Support online firmware upgrade
- Support Dynamic Power Modulation (DPM) for insufficient USB power source
  - ◇ Support low voltage charger of 5V/500mA
- Input overvoltage, overcurrent protection
- Support PD3.0 input
- Support NTC
- 2 LEDs for system states indication
- Package: QFN32 5mm\*5mm 0.5 pitch

### Description

IP6808 is a wireless power transmitter controller SoC that integrates all required functions for the latest WPC Qi V1.2.4 specifications compliant wireless power transmitter design. Support A11 coil, support 5W, Apple 7.5W, Samsung 10W charging. It used analog PING to detect a RX wireless device for charging with low standby power. Once RX device is detected, the IP6808 establish a communication with the RX wireless device and controls the coil power transfer by adjusting operation frequency, depended on calculating the data packages, received from RX device, with PID algorithm. IP6808 terminate power transfer when RX device is fully charged.

IP6808 integrate full-bridge driver, includes voltage and current two-way ASK demodulation module, and input overvoltage/current protection and FOD module. IP6808 is a highly integrated SoC for small-size and low bom cost solutions and reduced time-to-market.

### Applications

- Charge Jacket, wireless charging base
- Car wireless charging device

## System Functional Diagram

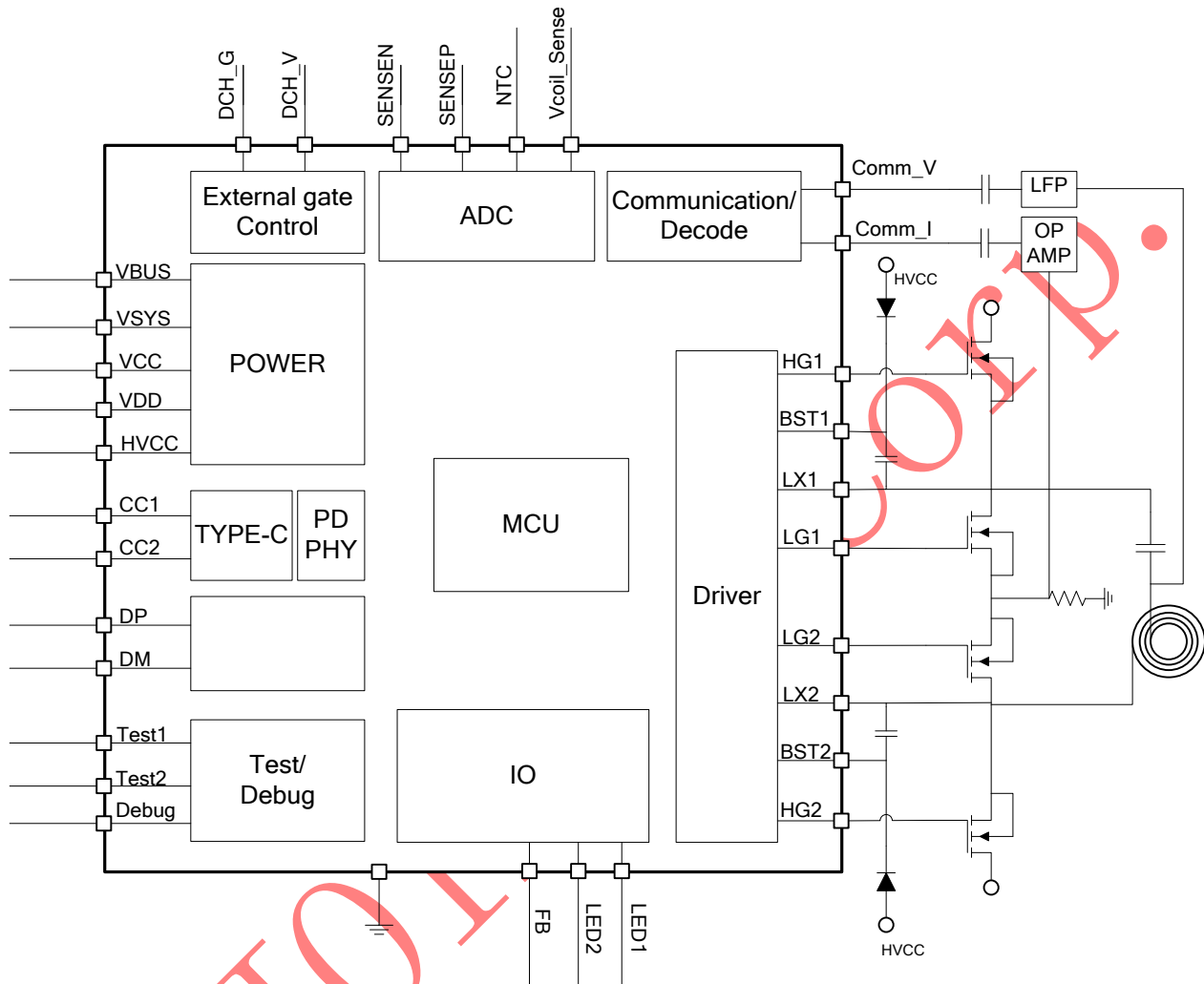
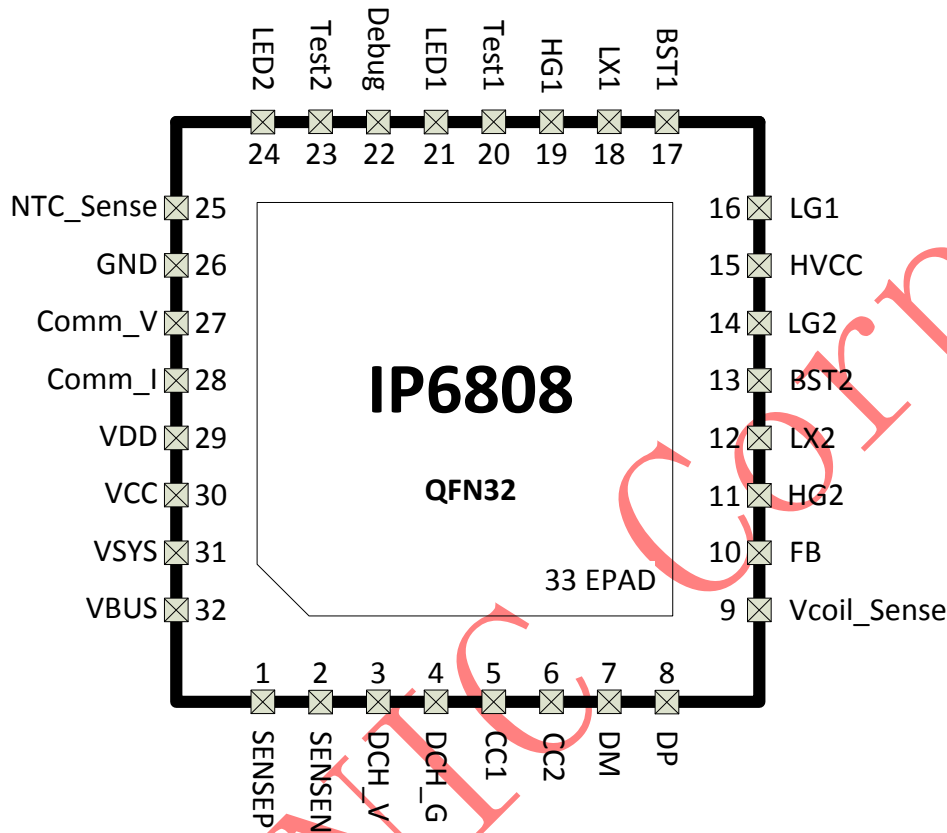


Figure System functional diagram

## Product Package Introduction

Product	Description
IP6808_5W	5W wireless charging application, support 5V DC input
IP6808_10W	5W~10W wireless charging application, same application schematic diagram with IP6808_5W, support 5V/9V DC input
IP6808_10W_DC	5W~10W wireless charging application, additional DCDC is added, support 5V/9V DC input

## 1. Pin Description



Pin No.	Pin Name	Description
1	SENSEP	VBUS current positive sense node
2	SENSEN	VBUS current negative sense node
3	DCH_V	Power rail voltage detect pin, can be float when external PMOS is not used
4	DCH_G	Control the gate of external PMOS, can be float when external PMOS is not used
5	CC1	Type-C port CC1 line, support firmware upgrade. Connect to ID line when applied in Micro USB port
6	CC2	Type-C port CC2 line, support firmware upgrade
7	DM	USB DM
8	DP	USB DP
9	Vcoil_Sense	Coil voltage sense input
10	FB	External DCDC voltage control pin
11	HG2	H-bridge high-side NMOS drive
12	LX2	H-bridge switching node
13	BST2	Internal high voltage drive, connect to capacitor to LX2

14	LG2	H-bridge low-side NMOS drive
15	HVCC	5V LDO output, used for H-bridge high-sied MOSFET boost drive
16	LG1	H-bridge low-side NMOS drive
17	BST1	Internal high voltage drive, connect to capacitor to LX1
18	LX1	H-bridge switching node
19	HG1	H-bridge high-side NMOS drive
20	Test1	Test1
21	LED1	LED1 output
22	DEBUG	Debug pin
23	Test2	Test2
24	LED2	LED2 output
25	NTC_Sense	NTC output
26	GND	Analog Ground
27	Comm_V	Voltage communication/demodulation input
28	Comm_I	Current communication/demodulation input
29	VDD	VDD internal power source output, connect to 1uF capacitor
30	VCC	VCC internal power source output, connect to 1uF capacitor
31	VSYS	System power input
32	VBUS	VBUS charge/discharge detect pin
33	EPAD (PGND)	Power dissipation ground, connect with ground well

## 2. Absolute Maximum Ratings

Parameters	Symbol	Min	Max	Unit
Input Voltage Range	VBUS	-0.3	25	V
	VSYS	-0.3	6	
	VCC	-0.3	5	
	DCH_V	-0.3	25	
	SENSEN	-0.3	25	
	SENSEP	-0.3	25	
Output Voltage Range	VCC	-0.3	3.3	V
	VDD	-0.3	2.2	
I/O Voltage Range	LED1,LED2	-0.3	VCC+0.3	V
	TEST1, TEST2	-0.3	VCC+0.3	
	CC1, CC2	-0.3	25	
	DP, DM	-0.3	20	
Junction Temperature Range	T <sub>J</sub>	-40	125	°C
Storage Temperature Range	T <sub>stg</sub>	-60	125	°C
Package Thermal Resistance	θ <sub>JA</sub>	18		°C/W
Human Body Model (HBM)	ESD			V

\*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.

## 3. Recommended Operating Conditions

Parameters	Symbol	Min	Typ	Max	Unit
Input Voltage Range	VBUS	4.5		22	V
	VSYS	2.9		7.4	
	VCC	2.8		3.3	
I/O Voltage Range	LED1,LED2	GND-0.3V		VCC+0.3V	V
	TEST1, TEST2	GND-0.3V		VCC+0.3V	
	CC1, CC2	GND-0.3V		5.5	
	DP, DM	GND-0.3V		5.5	

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

## 4. Electrical Characteristics

Unless otherwise specified, TA =25°C

Parameters	Symbol	Min	Typ	Max	Unit	Test Condition
HVCC			5		V	BST
VCC			3.15		V	
VDD			1.8		V	
VBUS		4.5		22	V	

Parameters	Symbol	Min	Typ	Max	Unit	Test Condition
VIH	Input high level	0.7x VCC			V	
VIL	Input low level			0.3x VCC	V	
VOH	Input high level		VCC		V	
VOL	Input low level		GND		V	
Rpu	Pull-up resistor		10		k	Pull-up resistor enable
Source current	Output current capability		2	4	mA	Source current to output high level is 0.8*VCC

## 5. Function Description

### Full-bridge/half-bridge Drive

IP6808 includes two symmetry half-bridge drive module, support multi-level of deadtime control and drive capability control to match with various external NMOS. PWM frequency adjustable range is 110kHz~205kHz with 0.25kHz/step.

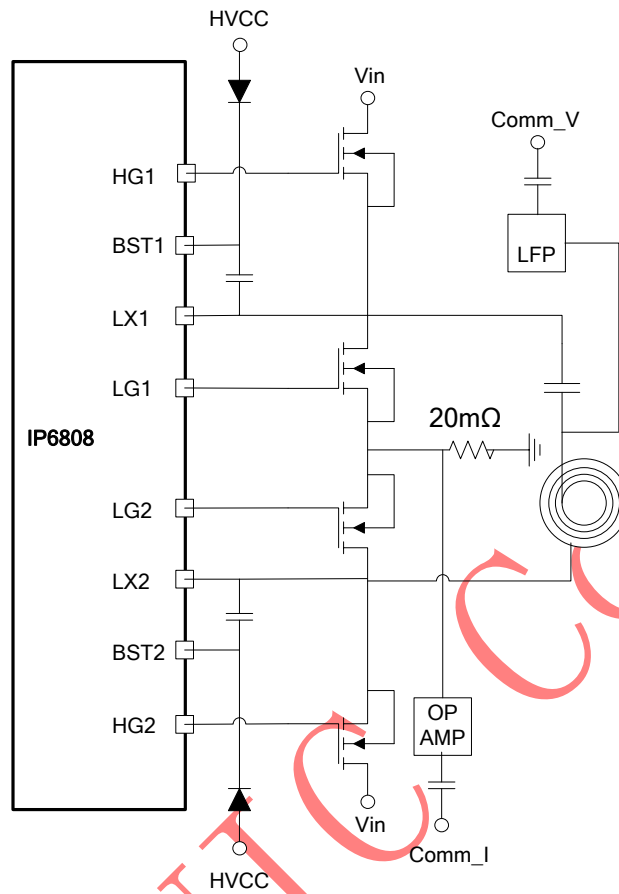


Figure full-bridge drive application circuit

## DPM

IP6808 support Dynamic Power Management function for USB power source with insufficient power supply ability, which can guarantee the charging status will not break off or suspend. When the system detect the input voltage is lower than 4.0V, DPM function will be enabled and the transmitting power will be reduced. When the input voltage returns to above 4.8V and the input current is reduced by 200mA compared to when entering DPM, the system exits the DPM state.

## Digital Demodulation

Integrate two-way ASK demodulation module, sampling the voltage and current of the coil separately. Current demodulation, additional separate devices are needed for low pass filters and first amplifier, signals is send to IC for digital demodulation and decode after DC blocked.

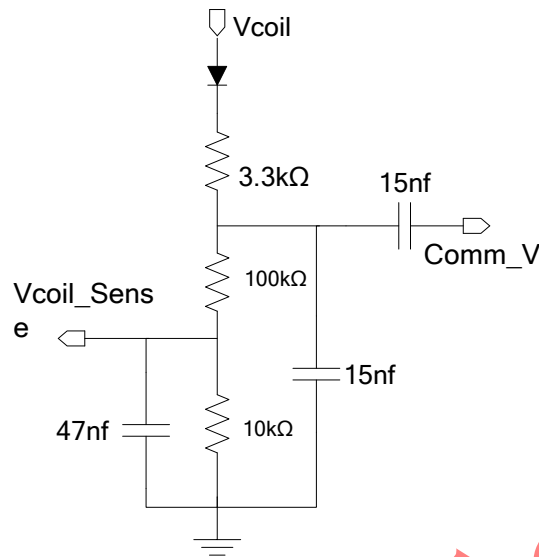


Figure Voltage ASK demodulation external circuit

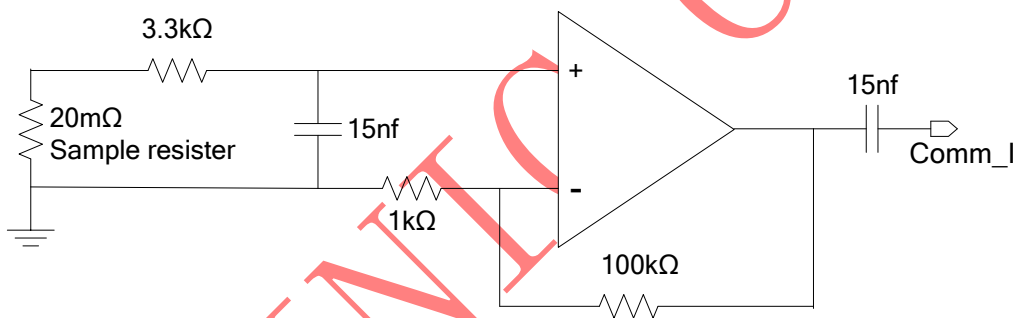


Figure Current ASK demodulation external circuit

## NTC Thermal Protection

IP6808 5W typical application do not need additional thermal protection. The NTC thermal shutdown protection is for enhancement application, but not limited to thermal shutdown. When NTC voltage is lower than 1V, the system will terminate the power transmission. After entering NTC protection, the NTC voltage is greater than 1.3V, and normal charging resumes. If NTC is not used, NTC pin must pull high.

NTC resistor selection, refer to the following stage:

1. Refer to NTC resistor data handbook, search the resistor-temperature relation sheet
2. Find the related resistor  $R_{NTC}$  according to the protection temperature
3. Calculate the pull-up resistor  $R_{SetPoint}$  value according to the expression:  $R_{SetPoint} = (VCC-1) \cdot R_{NTC}$



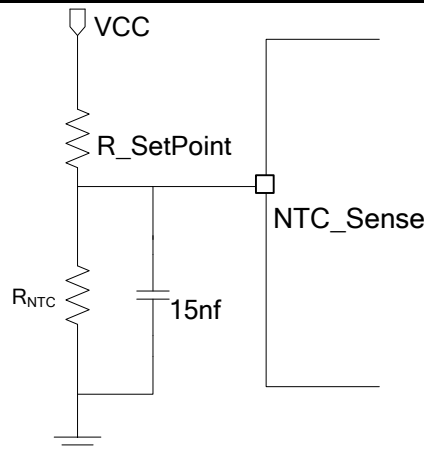


Figure NTC application

## LED Status Indicator

IP6808 can drive 2 LEDs directly through serial current-limit resistor. LEDs' status and system status relations are listed below:

Status	LED2	LED1
Over temperature	toggle	Toggle
Trigger VBUS input undervoltage loop	toggle	On
Overvoltage/overcurrent	toggle	Off
FOD	On	Off
Charging accomplished	On	On
In charging	Off	Toggle
Normal	Off	On

Toggle: 500ms high level->500ms low level->500ms high level

On: high level

Off: low level

## Firmware Upgrade

Different wireless charging application regulation method is different, different applications has its own firmware and can not be exchanged, otherwise abnormal working situation may occur and lead to high voltage at RX side.

Method 1:

Use TEST1, TEST2 two pins for firmware upgrade, it is not convenient for online upgrade, test points should be reserved on PCB board for debug and upgrade.

Method 2:

In Type-C USB application, the standard Type-C firmware upgrade method can be used for online upgrade, a firmware upgrade tool is provided for IP6808.

Method 3:

In Micro USB application, if online upgrade is needed, connect CC1 pin to ID line of Micro USB port, and use

dedicated firmware upgrade tool for IP6808.

## 6. Test Waveform

Using TI bq51020 solution for RX device, the relationship of efficiency and system output power and test method are outlined below. (V<sub>OUT</sub>=5V).

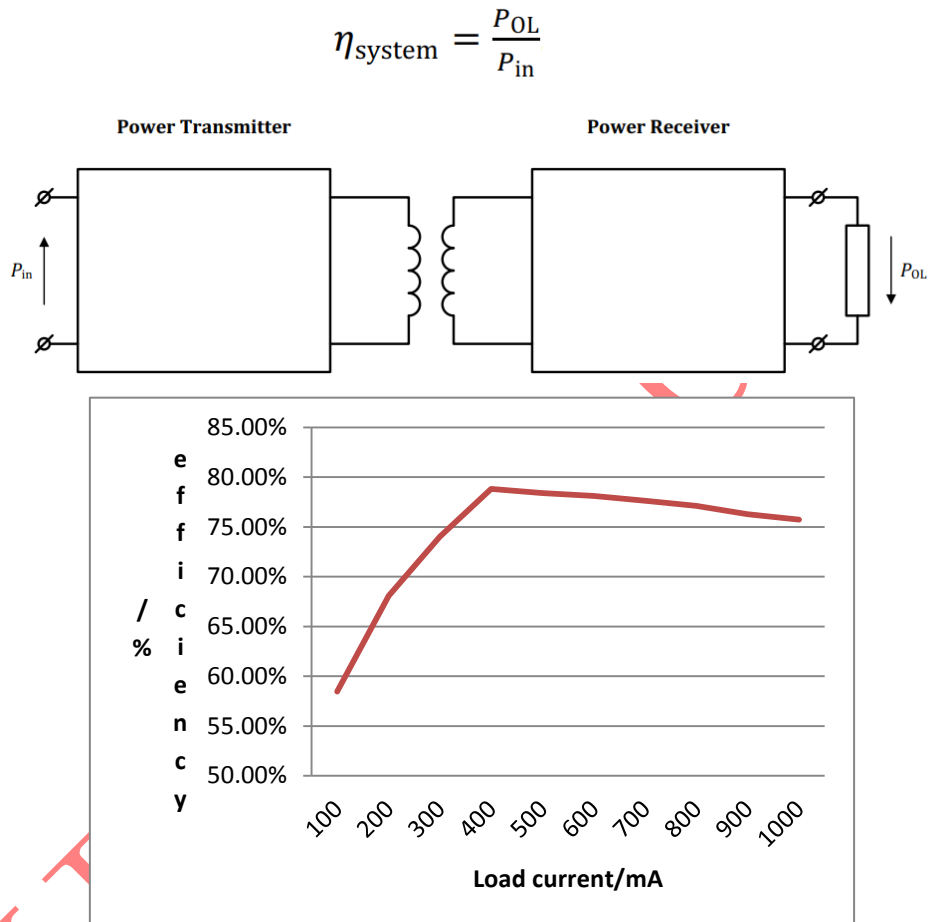
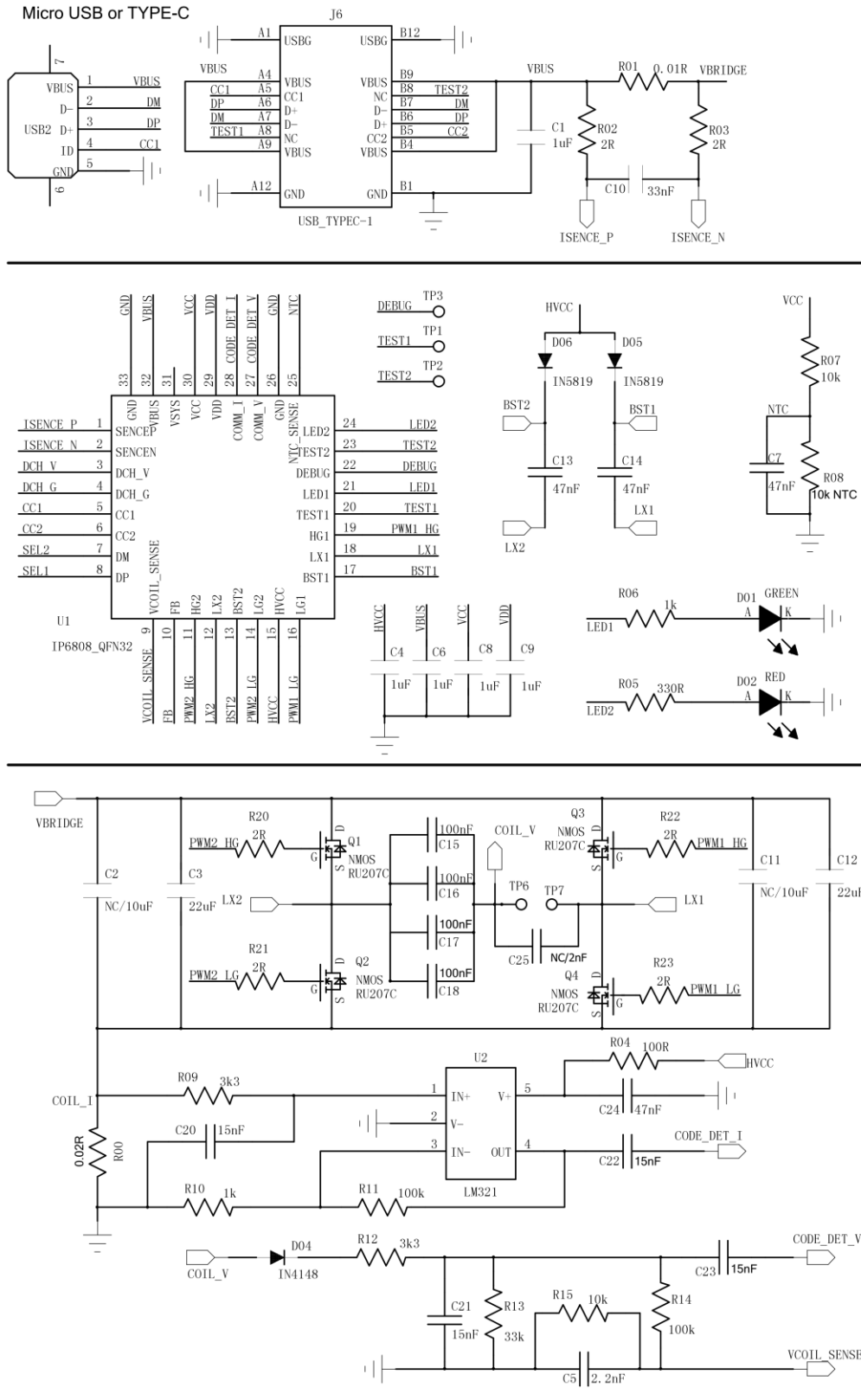


Figure System efficiency (using bq51020 RX)

## 7. Typical Application Schematic

IP6808 wireless charging solution only needs MOSFET, a OP amp, capacitors, resistors and few passive devices.

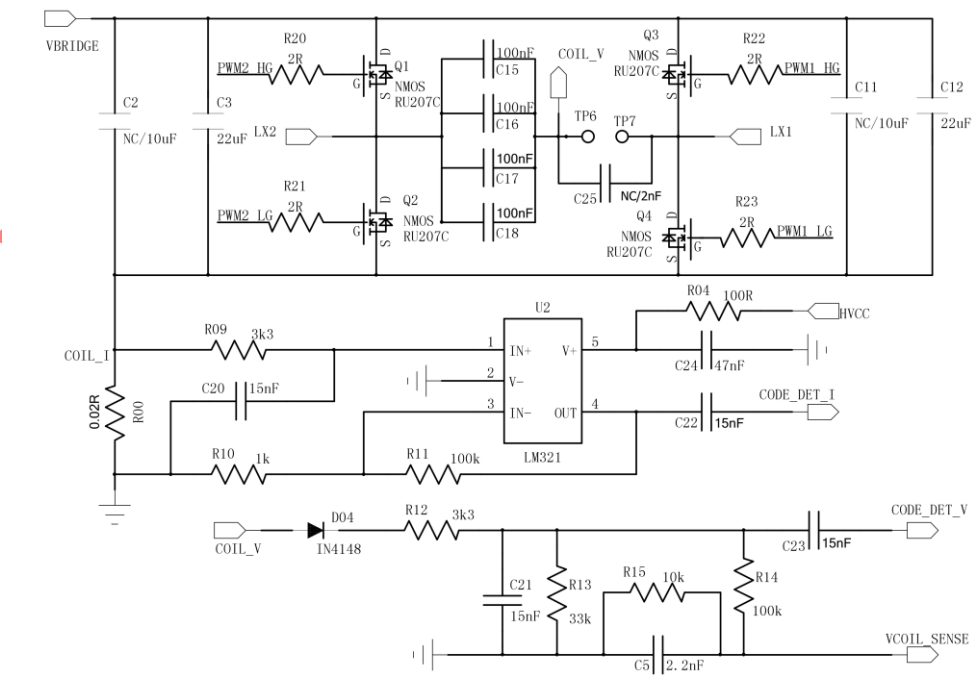
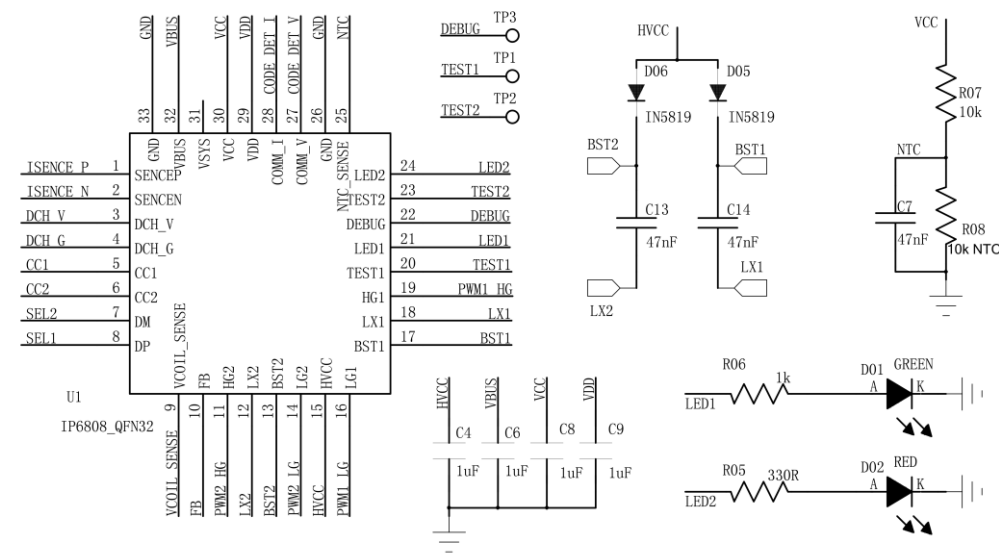
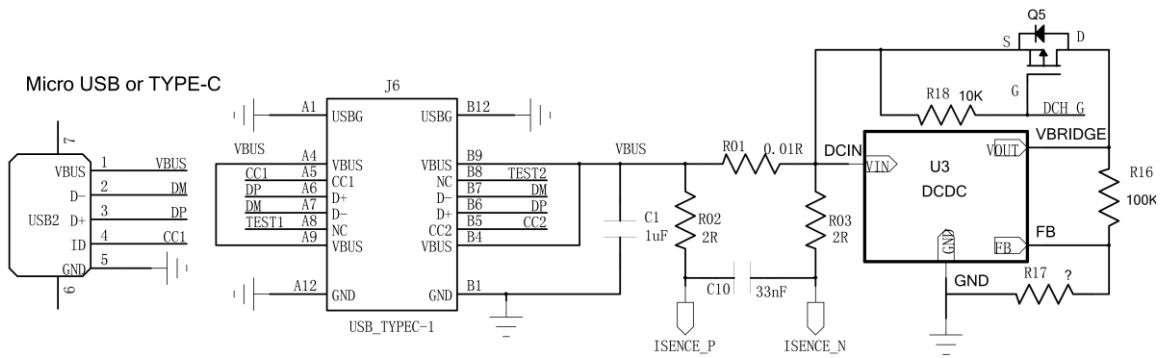
## 5W~10W non-DCDC Application



## BOM List

Item	Qty	Reference	Part Name	Description
1	1	U1	IP6808_5W or IP6808_10W	IP6808_QFN32
2	4	Q1-4	NMOS,RU207C	Full-bridge NMOS
3	1	U2	LM321 or BL321	OP amp
4	2	TP6-7	A11	Wireless charging coil
5	1	D04	DIODE,IN4148 or IN5819	Diode
6	2	D05-06	DIODE,IN5819	Schottky diode
7	1	D01	LED_BLUE, GREEN	LED
8	1	D02	LED_BLUE, RED	LED
9	1	R00	1210R,0.02R,1%	SMD resistor
10	1	R01	1210R,0.01R,1%	SMD resistor
11	1	R04	R0603,100R	SMD resistor
12	2	R11,R14	R0603,100k	SMD resistor
13	2	R07,R15	R0603,10k	SMD resistor
14	1	R08	R0603,10k NTC	SMD resistor
15	2	R06,R10	R0603,1k	SMD resistor
16	2	R02-03	R0603,2R	SMD resistor
17	1	R05	R0603,330R	SMD resistor
18	1	R13	R0603,33k	SMD resistor
19	2	R09,R12	R0603,3k3	SMD resistor
20	4	C15-18	C1210,100nF,100V	NPO or CBB capacitor
21	4	C20-23	C0603,15nF	SMD capacitor
22	5	C5,C7,C13-14,C24	C0603,47nF	SMD capacitor
23	1	C25	C0603,NC/2nF	SMD capacitor
24	5	C1,C4,C6,C8-9	C0603,1uF,10%	SMD capacitor
25	2	C3,C12	C0805,22uF,10%	SMD capacitor
26	1	C10	C0603,33nF,10%	SMD capacitor
27	2	C2,C11	C0603,NC/10uF,10%	SMD capacitor
28	1	USB2	MINIUSB_7PIN	Micro_USB
29	1	J6	USB_TYPEC-1	TYPEC
30	3	TP1-3	TP,nc	Test point

## 5W~10W with DCDC



## BOM List

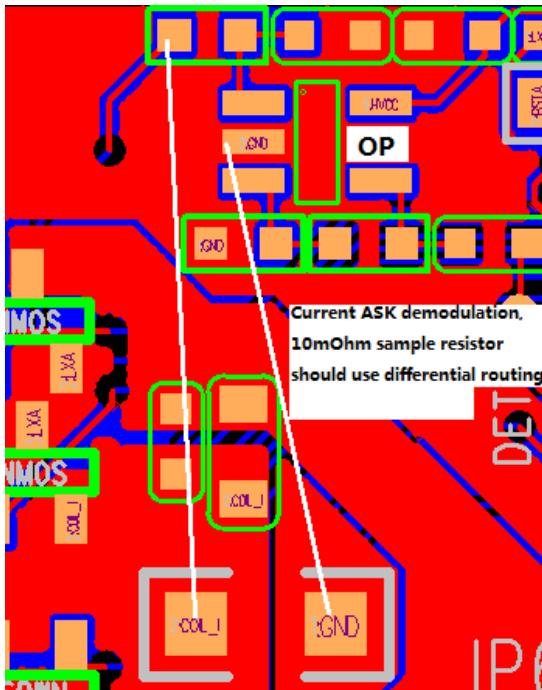
Item	Qty	Reference	Part Name	Description
1	1	U1	IP6808_10W_DC	IP6808_QFN32
2	4	Q1-4	NMOS,RU207C	Full-bridge NMOS
3	1	Q5	PMOS,RU20P7C	PMOS
4	1	U2	LM321 or BL321	OP amp
5	1	U3	SCT2321 or other DCDC	DCDC IC
6	2	TP6-7	A11	Wireless charging coil
7	1	D04	DIODE,IN4148 or IN5819	Diode
8	2	D05-06	DIODE,IN5819	Schottky diode
9	1	D01	LED_BLUE,GREEN	LED
10	1	D02	LED_BLUE,RED	LED
11	1	R00	1210R,0.02R,1%	SMD resistor
12	1	R01	1210R,0.01R,1%	SMD resistor
13	1	R04	R0603,100R	SMD resistor
14	3	R11,R14,R16	R0603,100k	SMD resistor
15	3	R07,R15,R18	R0603,10k	SMD resistor
16	1	R08	R0603,10k NTC	SMD resistor
17	2	R06,R10	R0603,1k	SMD resistor
18	2	R02-03	R0603,2R	SMD resistor
19	1	R05	R0603,330R	SMD resistor
20	1	R13	R0603,33k	SMD resistor
21	2	R09,R12	R0603,3k3	SMD resistor
22	1	R17	R0603,? (resistor is related to FB voltage)	SMD resistor
23	4	C15-18	C1210,100nF,100V	NPO or CBB capacitor
24	1	C5	C0603,2.2nf	SMD capacitor
25	4	C20-23	C0603,15nF	SMD capacitor
26	4	C7,C13-14,C24	C0603,47nF	SMD capacitor
27	1	C25	C0603,NC/2nF	SMD capacitor
28	5	C1,C4,C6,C8-9	C0603,1uF,10%	SMD capacitor
29	2	C3,C12	C0805,22uF,10%	SMD capacitor
30	1	C10	C0603,33nF,10%	SMD capacitor
31	2	C2,C11	C0603,NC/10uF,10%	SMD capacitor
32	1	USB2	MINIUSB_7PIN	Micro_USB
33	1	J6	USB_TYPEC-1	TYPEC
34	3	TP1-3	TP,nc	Test point

## 8. Layout Notifications

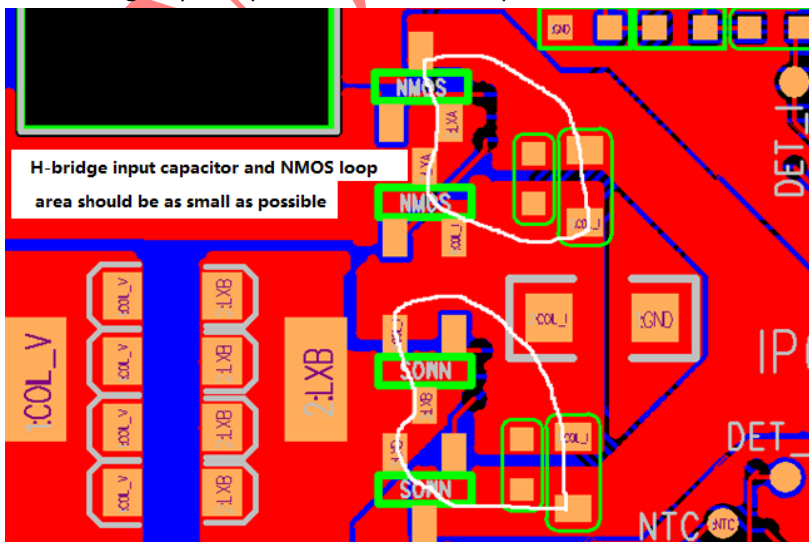
Here list some notifications that may affect the function and performance, other notes will be described in other attached files.

Layout methods has great influence on function and performance of the wireless charging system, un-appropriate layout may affect the ASK communication and the sensitivity of FOD detection.

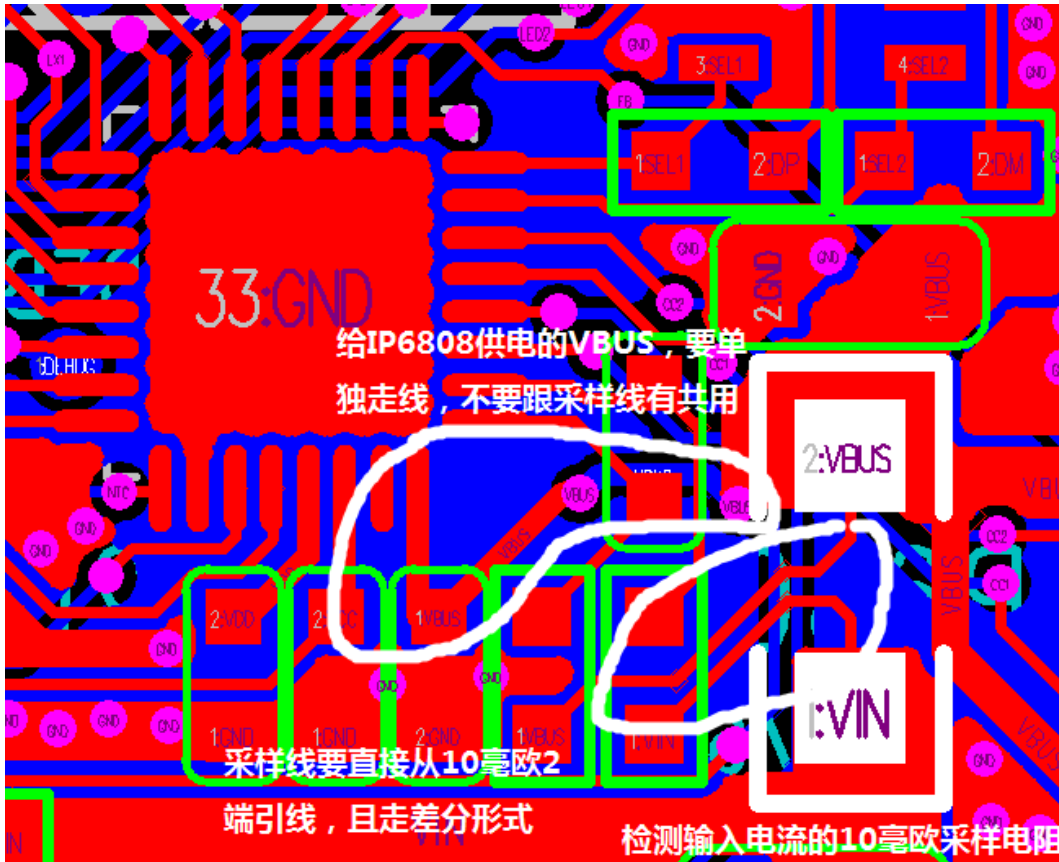
1. Make sure IP6808 pins and EPAD GND PAD has a good continuous current loop.
2. The 20mOhm sample resistor for current demodulating , should differentially layout to OP amp inputs or use other low noise interference method.



3. CODE\_DET\_I and CODE\_DET\_V are sensitive signals should be wrapped up by ground and placed far away from switching MOSFET.
4. H-bridge input capacitor and NMOS loop area should be as small as possible.

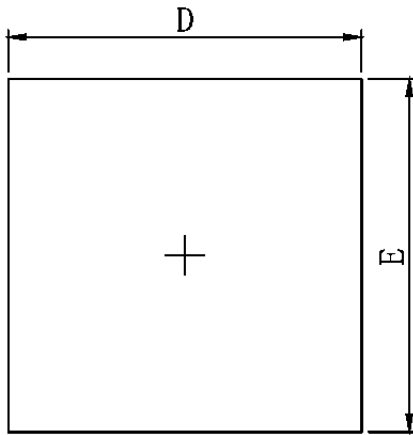


5. The 10mOhm sample resistor for the input current detecting ,the sampling line should be directly from the the sample resistor at both ends of the lead; pay attention to the IP6808 32 pin power supply VBUS routing, to separate the line, do not It is coincident with the sampling line of VBUS (the 1 pin);

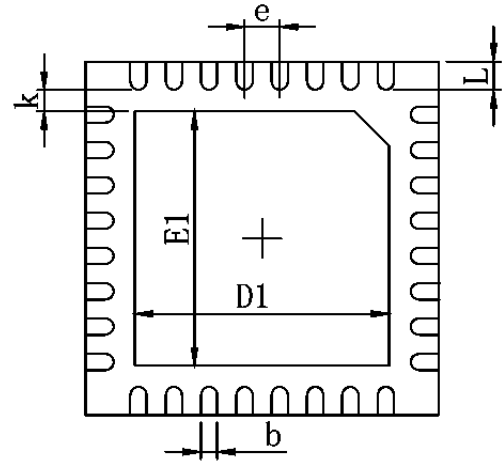




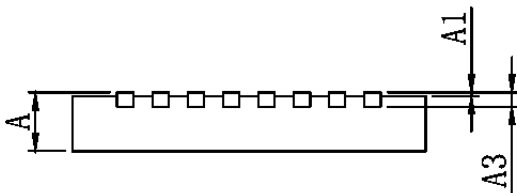
## 9. Package



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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