

Highly intergrated 5W wireless charging transmitter controller

1 Features

- **Compliant with WPC specification transmitter design**
- **Support 5W applications**
- **Support FOD (Foreign Object Detection) function**
 - ✧ **High sensitivity**
 - ✧ **Support dynamic FOD**
- **Low quiescent dissipation and high efficiency**
 - ✧ **4mA quiescent current**
 - ✧ **Low power automatic detection**
 - ✧ **Charging efficiency is up to 78%**
- **Adaptive charging current adjustment (DPM)**
 - ✧ **Compatible with all adapters on the market**
 - ✧ **Support low voltage charger of 5V/500mA**
- **Minimal BOM**
 - ✧ **Integrate NMOS full bridge driver and full bridge power MOS**
 - ✧ **Integrate voltage demodulator**
 - ✧ **Integrate current demodulator**
- **Multiple protection, high reliability**
 - ✧ **Input overvoltage, undervoltage, overcurrent protection**
 - ✧ **NTC Overtemperature protection**
 - ✧ **ESD 4KV**
 - ✧ **Input withstand voltage up to 16V**
- **Status indication**
 - ✧ **Supports up to 2 LEDs for system states indication**
 - ✧ **Various charge status indications**
- **Firmware upgrades**
 - ✧ **OTP Memory**
 - ✧ **Support firmware upgrade unrepeatedly**
- **Compatible with NPO and CBB capacitors**
- **Package: 3 mm × 3 mm 0.5pitch QFN16**

2 Applications

- **Wireless charging base**

3 Description

IP6825 is a wireless power transmitter controller SoC that integrates all required functions for WPC Qi specifications compliant wireless power transmitter design. Support A11 coil, support 5W charging.

It used Analog Ping to detect a RX wireless device for charging with low standby power. Communication with the wireless charger receiver is established via Digital Ping, and after successful communication, power transmission begins.

Once RX device is detected, the IP6825 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. IP6825 terminates power transmission once the battery on the receiver is fully charged.

IP6825 integrate full-bridge driver and full bridge power MOS, includes voltage and current two-way ASK demodulation module, and input overvoltage/current protection and FOD module. IP6805U is a highly integrated SoC for small-size and low bom cost solutions and reduced time-to-market.

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4 Reversion History

Note: The page number of the previous version may be different from the page number of the current version.

First edition release (August 2022)

5 Simplified Application Schematics

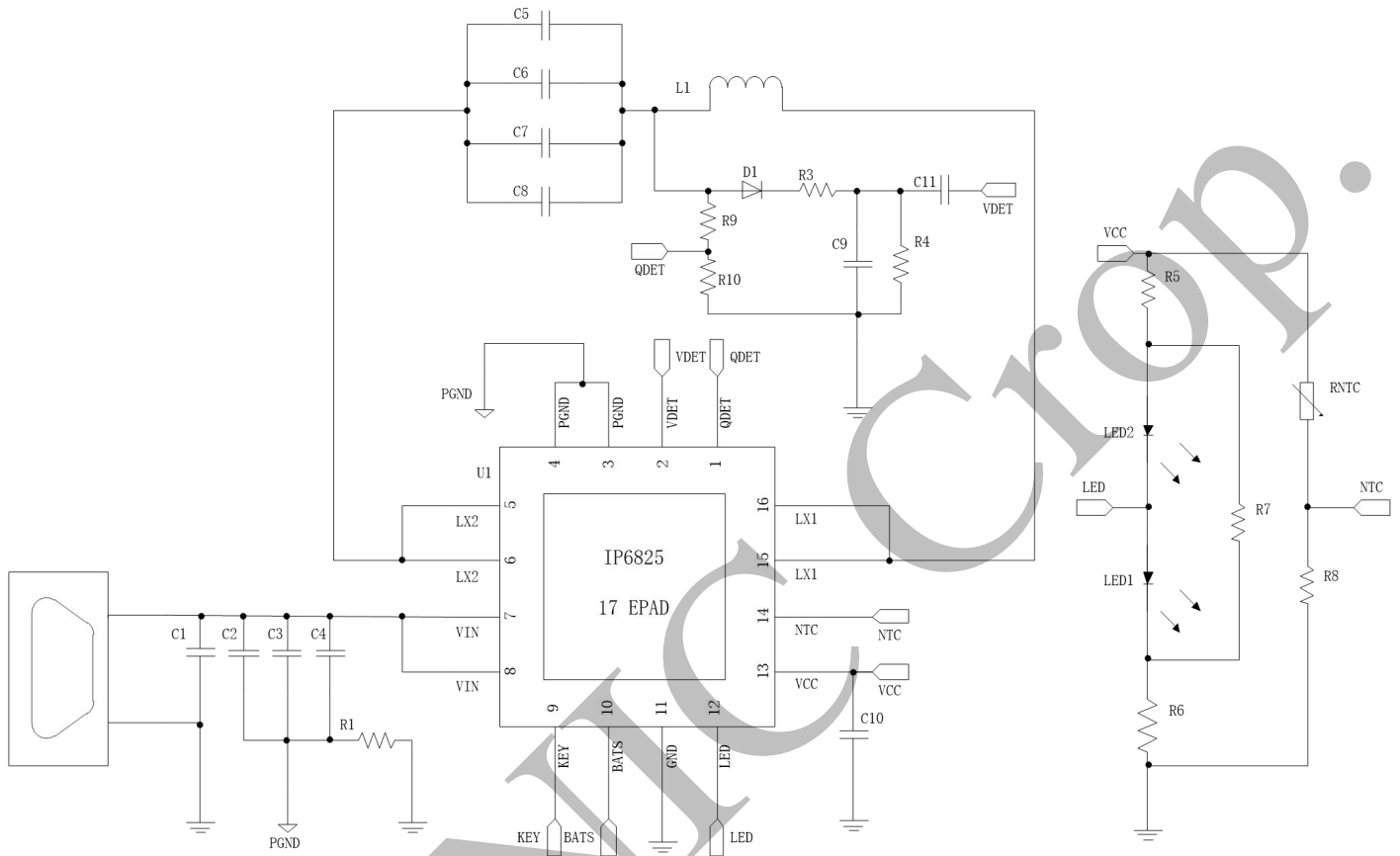


Figure 1 Simplified application schematics

6 Pin Configuration And Function

6.1 Pin Diagram

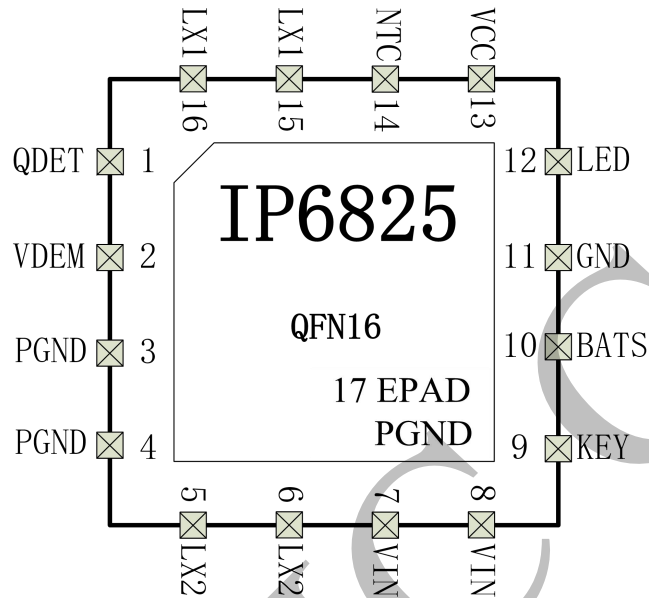


Figure 2 IP6825 Pin Diagram

6.2 Pin Description

Pin No.	Pin Name	Description
1	QDET	Voltage coil Q-value detection
2	VDEM	Voltage communication/demodulation input
3	PGND	The power ground of the internal power MOS transistor is connected to the external 20 mΩ sampling resistor positive terminal
4	PGND	The power ground of the internal power MOS transistor is connected to the external 20 mΩ sampling resistor positive terminal
5	LX2	H-bridge switching node 2
6	LX2	H-bridge switching node 2
7	VIN	External voltage input PIN
8	VIN	External voltage input PIN
9	KEY	Pushbutton signal input PIN
10	BATS	Battery supply PIN
11	GND	Analog Ground
12	LED	LED Driver PIN
13	VCC	Internal VCC supply, connect 2.2uF capacitor
14	NTC	NTC input PIN
15	LX1	H-bridge switching node 1
16	LX1	H-bridge switching node 1

17(EPAD)	EPAD	The power ground of the internal power MOS transistor is connected to the external 20 mΩ sampling resistor positive terminal
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7 System Functional Diagram

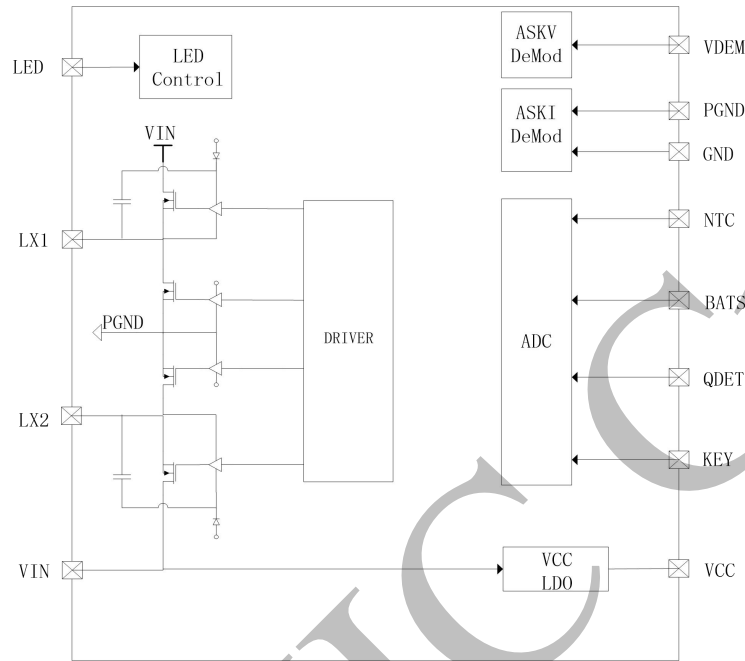


Figure 3 System Functional Diagram

8 Absolute Maximum Ratings

Parameters	Symbol	Min	Max	Unit
Input Voltage Range	VIN	-0.3	16	V
Junction Temperature Range	T _J	-40	125	°C
Storage Temperature Range	T _{stg}	-60	125	°C
Package Thermal Resistance	θ _{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.

9 Recommended Operating Conditions

Parameters	Symbol	Min	Typ	Max	Unit
VIN input Voltage Range	VIN	4.5	5	5	V
VCC Voltage Range	VCC	3.0	3.5	5	V
I/O Voltage Range	LED	GND-0.3		VCC+0.3	V
	NTC	GND-0.3		VCC+0.3	

	KEY	GND-0.3		VCC+0.3	
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*Devices' performance cannot be guaranteed when working beyond those Recommended Operating Conditions.

*The default input voltage overvoltage setting is 6.5V, if you need to support 9V charging then you need to modify the overvoltage voltage.

10 ELECTRICAL CHARACTERISTICS

Unless otherwise specified, TA =25°C

Parameters	Symbol	Min	Typ	Max	Unit	Test Condition
Input Voltage	VIN	4.5	5	5	V	
Internal power supply	VCC	3.0	3.5	5	V	
Input high level	VIH	0.7xVCC			V	
Input low level	VIL			0.3xVCC	V	
Input high level	VOH		VCC		V	
Input low level	VOL		GND		V	
LED Output current capability	LED Source Current		2	4	mA	Source current to output high level is 0.8*VCC

11 Function Description

11.1 Full-bridge And Power MOS

IP6825 includes two symmetry half-bridge drive module with built-in power MOS, PWM frequency adjustable range is 110kHz~205kHz with 0.25kHz/step.

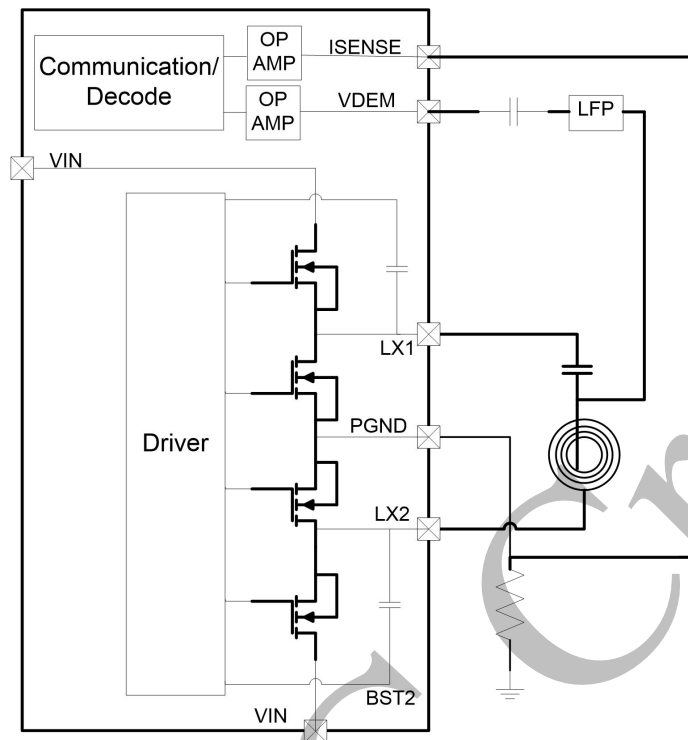


Figure 4 Full-bridge drive application circuit

11.2 DPM

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 4.2V, DPM function will be enabled and the transmitting power will be reduced. When the input voltage returns to above 4.4V and the input current is reduced by 200mA compared to when entering DPM, the system exits the DPM state.

11.3 Digital Demodulation

IP6825 integrate two-way ASK demodulation modules, which can collect coil voltage and current for ASK communication demodulation and decoding respectively. The current decoding gets the signal through the sampling resistor and sends it to IC for digital demodulation and decoding.

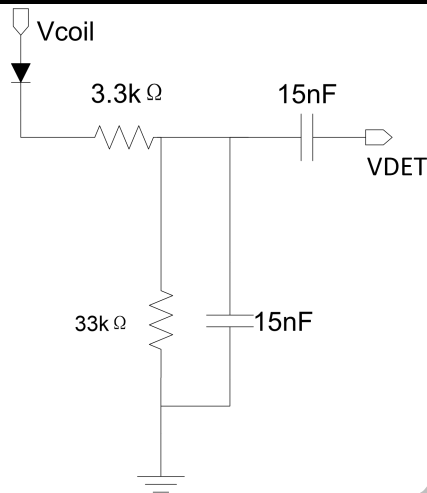


Figure 5 Voltage ASK demodulation external circuit

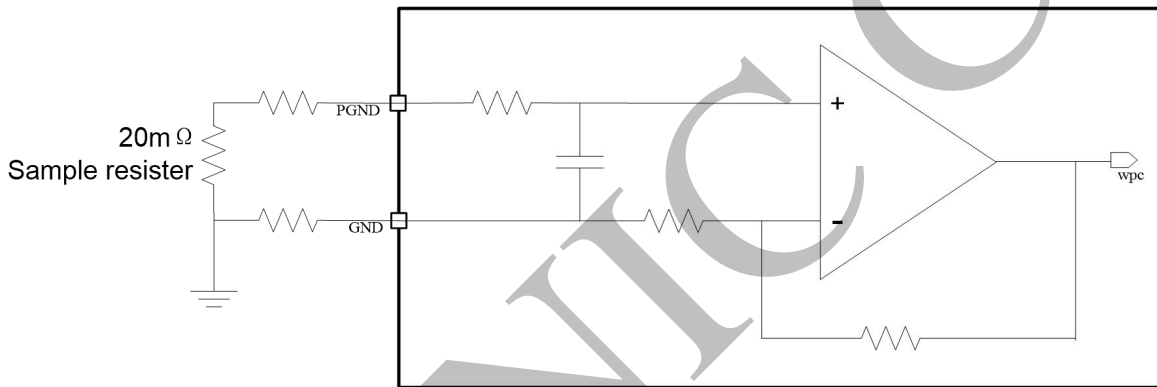


Figure 6 Current ASK demodulation external circuit

11.4 FOD Parameter Adjustment

IP6825 supports static FOD foreign object detection and dynamic FOD foreign object detection;

Static FOD means that foreign objects on the coil can be detected without wireless charging;

Dynamic FOD means that foreign objects on the coil can be detected while charging wirelessly, Need special custom firmware support if you need to adjust;

11.5 NTC Thermal Protection

The IP6805S supports NTC protection function. After VCC is divided by NTC thermistor and pull-down resistor, it is input to the NTC pin of IP6805S, and the system will end power transfer when the voltage of NTC pin is higher than 1/2 VCC voltage. When the voltage at the NTC pin is lower than 1/2 VCC-300mV after NTC protection, charging resumes. NTC protection when $R_{NTC} < R_{SetPoint}$.

NTC resistor selection 100k, B=3950.

Eg. If the protection temperature is 50°C, then $R_{SetPoint}=35k$

If the protection temperature is 60°C, then R_SetPoint=24k

If the protection temperature is 70°C, then R_SetPoint=17k

If the protection temperature is 80°C, then R_SetPoint=12k

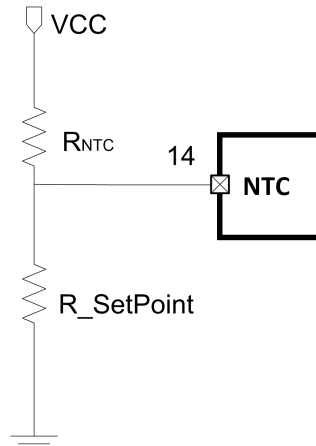


Figure 7 NTC circuit

11.6 LED Status Indicator

IP6825 can drive 2 LEDs via LED pin in Time Division Multiplexing. LEDs' status and system status relations are listed below:

Status	LED1	LED2
Power-on	After one alternate flash, light up once at the same time	
Standby	Off	Off
Charging	On	Off
Full charge	Off	On
Abnormal	Off	Flashing

Support configuration tool to modify firmware, supports up to 2 LEDs.

11.7 Test Waveform

Using IDT P9221 solution for RX device, the relationship of efficiency and system output power (VOUT=5V . test method are outlined below.).

$$\eta_{\text{system}} = \frac{P_{\text{OL}}}{P_{\text{in}}}$$

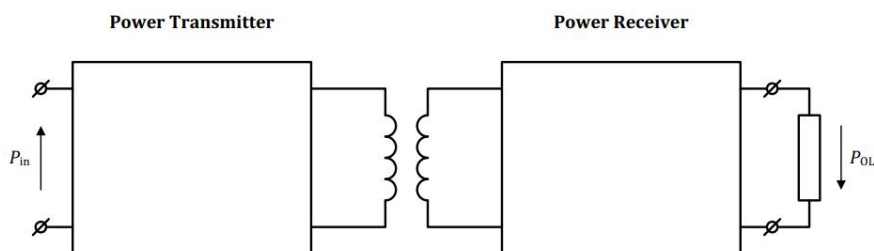


Figure 8 wireless charging power conversion model

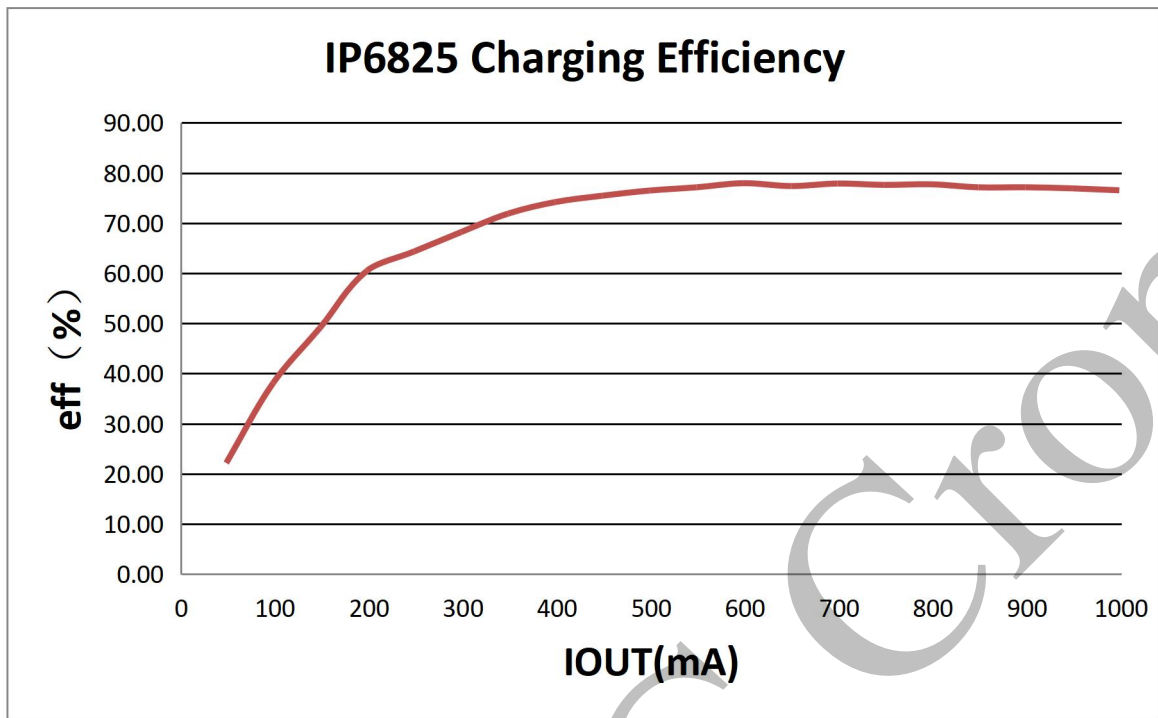


Figure 9 System efficiency(using IDT P9221 RX)

12 Typical Application Schematic

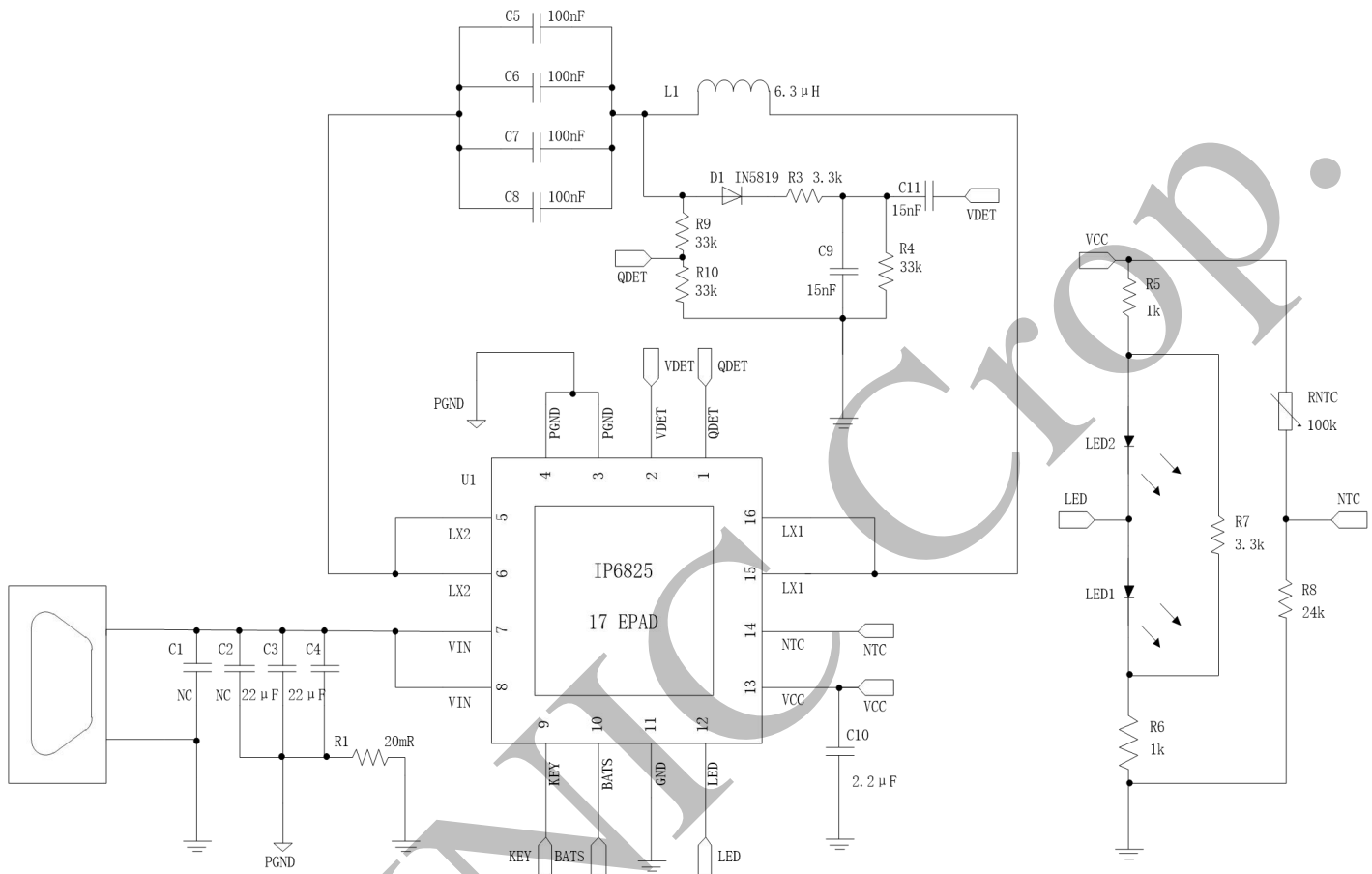


Figure 10 Typical Application Schematic

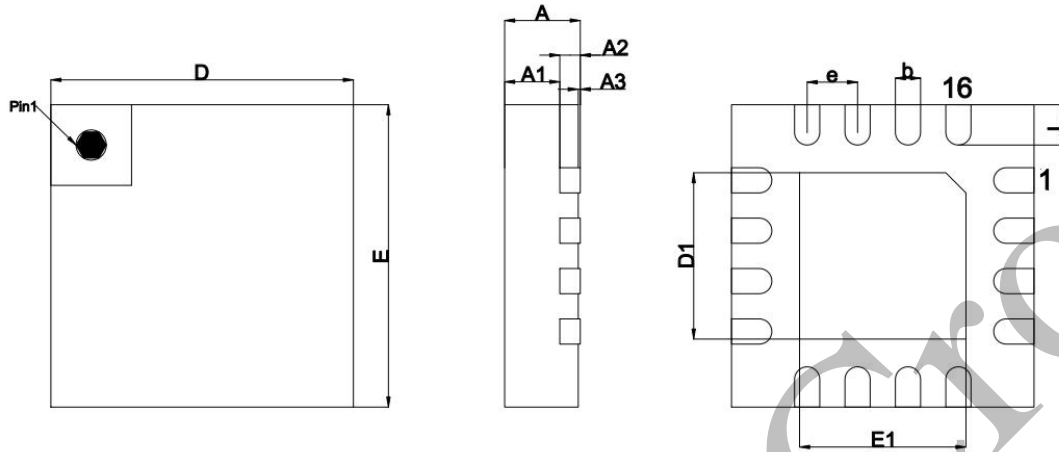
Description:

- (1) The EPAD of the IP6805S is PGND, and PGND and GND are connected through a 20mR resistor; the 20mR needs to be selected as a high precision sampling resistor.
- (2) C2, C3, C4 should be placed close to the VIN pin.
- (3) C10 should be placed close to the VCC pin.
- (4) The loop area of LX1 and LX2 should be as small as possible.

13 BOM

Item	Part Name	Description&specification	Description	Qty
1	IP6825	QFN16 IP6825	U1	1
2	NPO or CBB 电容	400nF 100V	C5-C6	4
3	SMD capacitor	0805C 22uF 25V	C3 C4	2
4	SMD capacitor	0603C 15nF 25V	C9 C11	2
5	SMD capacitor	0603C 2.2uF 25V	C10	1
6	Precision low temperature drift resistor	1206R 20mR 1%	R1	1
8	SMD resistor	0603R 3.3K	R3 R7	2
9	SMD resistor	0603R 33K	R4 R9 R10	3
10	SMD resistor	0603R 1K	R5 R6	2
11	SMD resistor	0603R 24K	R8	1
12	NTC thermistor	100K 25°C B=3950	RNTC	1
13	Schottky Barrier Diode	IN5819	D1	1
14	LED	0603D	LED1 LED2	2
15	Wireless charging coil	A11	L1	1

14 Package



	POD	QFN-16L-3X3X0.75-A_P0.5		
		Size unit: mm		
	Symbol	Minimum	Normal	Maximum
Total Thickness	A	0.70	0.75	0.80
Molding Thickness	A1	-	0.55	-
LF Thickness	A2	-	0.203	-
Stand Off	A3	0.00	0.02	0.05
Body Size	D	-	3.00	-
	E	-	3.00	-
Exposed Pad Size	D1	1.55	1.65	1.75
	E1	1.55	1.65	1.75
Lead Width	b	0.20	0.25	0.30
Lead Length	L	0.30	0.40	0.50
Lead Pitch	e	0.50 BSC		

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