

HUSB350 2C+1A 智能功率分配方案

参考设计简介

HUSB350 是 Hynetek 慧能泰最新推出的 PD3.0 PPS 协议芯片，主要指标如下：

- 通过 USB PD3.0 PPS 认证，TID 1508。
- 支持多达五档 FPDO 和二档 APDO。
- 支持 QC2.0/3.0, PD2.0/3.0, AFC, FCP, BC1.2 DCP, Apple 5V/2.4A 等充电协议。
- 支持线路阻抗补偿可选 0, 100mΩ 或 150mΩ。
- 支持三级智能降功率功能，适合 1C+1A, 1C+2A, 1C+3A, 2C, 2C+1A, 2C+2A 等不同组合。
- GPIO 引脚可配置成充电状态转灯和 Type-C 插入状态指示等功能。
- 集成 VCONN 电源和 USB 电子标签芯片 (eMarker) 检测功能，支持最大电流输出 6.3A。
- CC1 和 CC2 支持 28V 高压，避免与 VBUS 引脚短路风险。

我们制作了一个参考样机主板和三种参考样机小板。三个小板分别是 PD 小板，DC-DC 小板和 Type-A 小板。三个小板都可以通过插座灵活插拔到主板上。主板的输入母线接外部 AC-DC 功率级输出母线电压，通过插座给 DC-DC 小板和 Type-A 小板的输入端供电。DC-DC 小板的输出连接到主板上，再连接到 PD 小板的输入端。PD 小板由 HUSB350 控制，可以调节 DC-DC 功率级的电压输出，通过 Type-C 母座输出 PD 功率。Type-A 小板的输入端直接通过插座接到主板的输入端（也就是 AC-DC 功率级的输出），通过 Type-A 母座输出功率。Type-A 小板可以是 5V2.4A 的输出，也可以是 18W QC/AFC/FCP 输出。三个小板通过不同的组合，实现不同的输出功率组合，输出组合包括以下几种类型：

- 1C+1A
- 1C+2A
- 1C+3A
- 2C
- 2C+1A
- 2C+2A

本文主要介绍其中一种总输出功率为 60W 的智能功率分配方案：2C+1A。总输出功率为 60W，在不同输出组合的情况下，实现功率利用最大化。需要说明的是，我们的参考方案可以自由灵活组合。

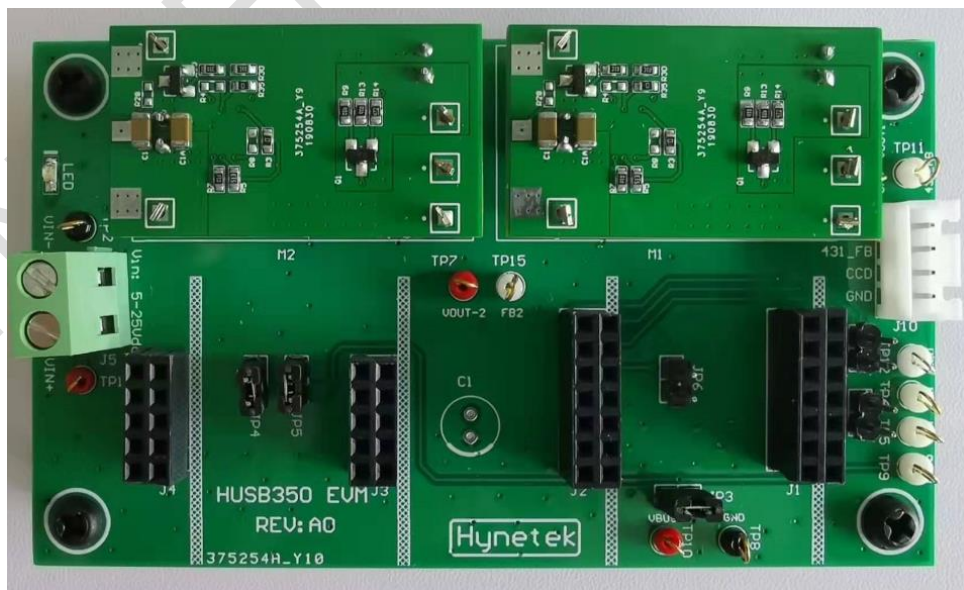


Figure 1. 主板实物



Figure 2 小板实物

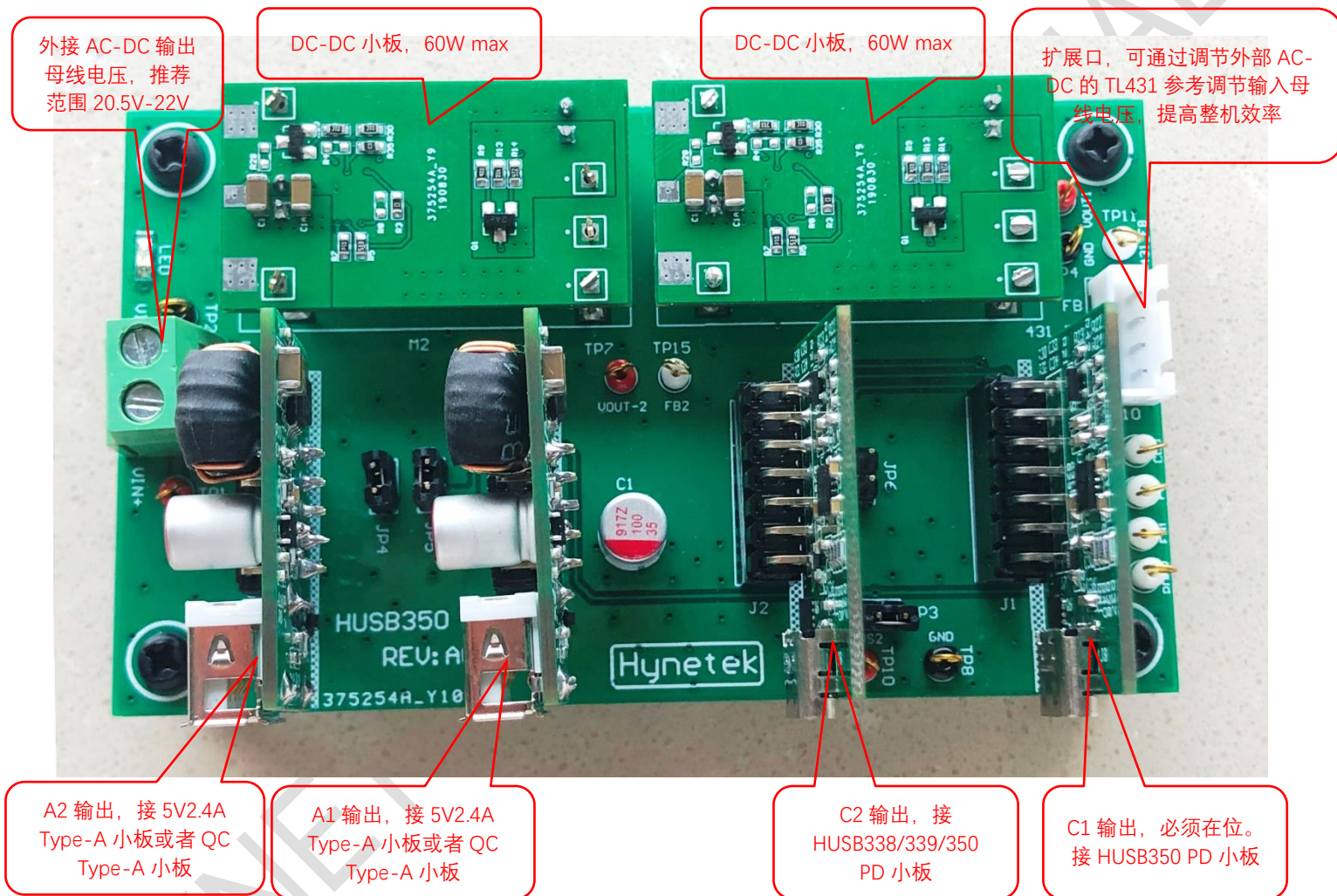


Figure 3. 参考设计的连接图

规格指标

Table 1. 总功率 60W 规格指标

类别	项目	规格指标
输入特性	输入电压范围	20.5V-22V (该电压通常接 AC-DC 输出母线电压)
C1 口输出特性	充电协议	PD2.0, PD3.0, PPS, QC2.0, QC3.0, AFC, FCP, BC 1.2 DCP, Apple 5V/2.4A
	单口使用输出电压电流	5V3A, 9V3A, 12V3A, 15V3A, 20V3A,
	多口使用输出电压电流	参考 Table 2
	最大输出功率	60W
C2 口输出特性	充电协议	PD2.0, PD3.0, PPS, QC2.0, QC3.0, AFC, FCP, BC 1.2 DCP, Apple 5V/2.4A
	输出电压电流	5V3A, 9V2A, 12V1.5A
	最大输出功率	18W
A1 口输出特性	充电协议	Apple 2.4A
	输出电压电流	5V2.4A
	输出功率	12W
	备注: A 口更换小板后可支持 18W QC3.0,	

Table 2. 多口使用各端口输出功率

在位与否			输出功率		
C1	C2	A1	C1	C2	A1
●	●	●	60W	-	-
●	●	●	42W	18W	-
●	●	●	30W	18W	12W
●	●	●	-	-	12W
●	●	●	-	18W	12W
●	●	●	42W	-	12W

备注: 更多组合不一一列举, 有任何疑问可联系慧能泰技术支持团队。

原理图

主板原理图如下所示:

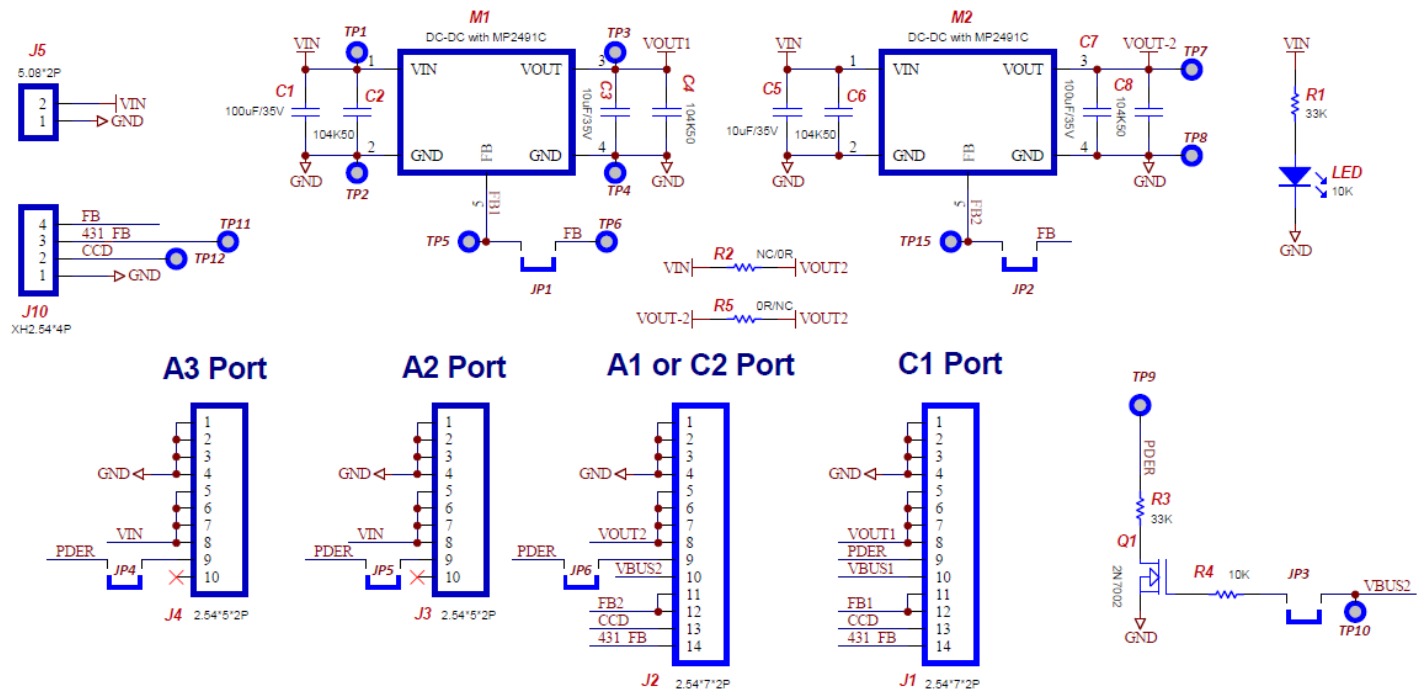


Figure 4.主板原理图

PD 小板原理图如下所示:

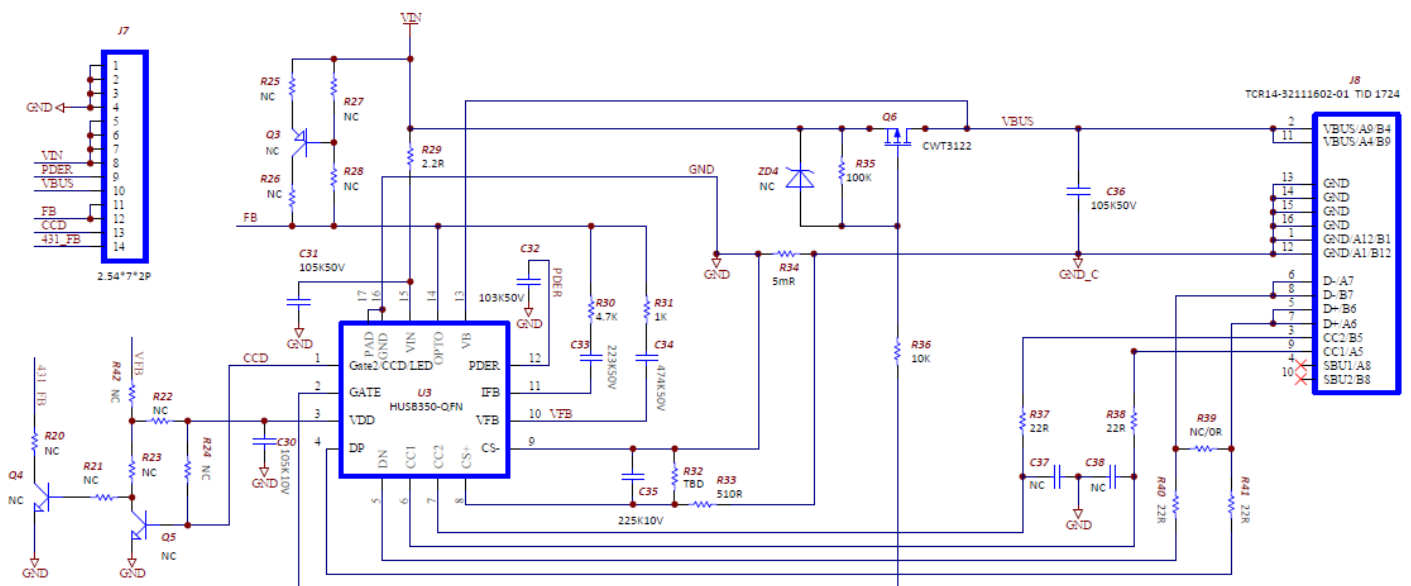


Figure 5. PD 小板原理图

Type-A 小板原理图如下所示:

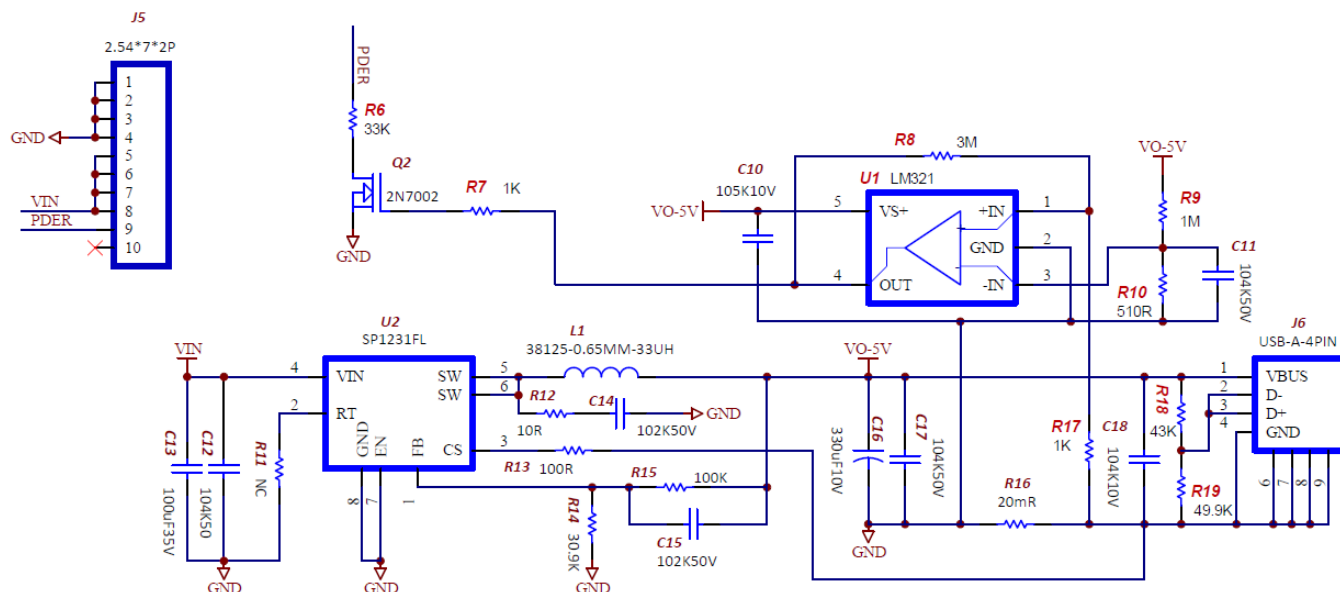


Figure 6. Type-A 小板原理图

DC-DC 小板原理图如下所示:

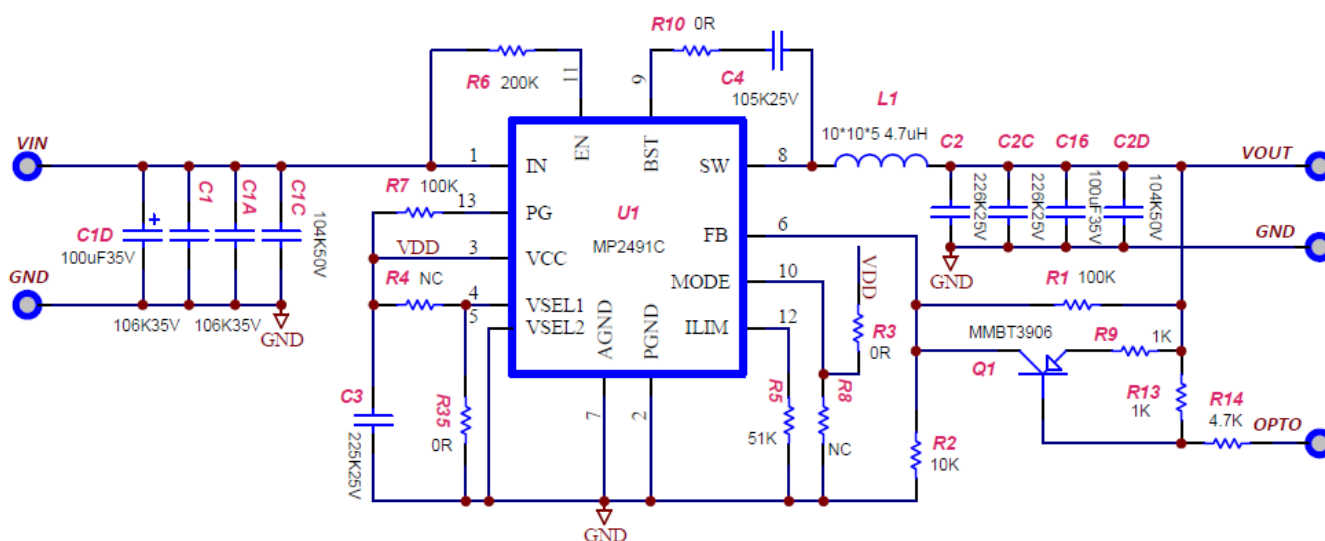


Figure 7. DC-DC 小板原理图

BOM 表

主板和三个小板的 BOM 表如表 3-表 6 所示。

Table 3. 主板 BOM 表

序号	物料名称	规格描述	位号	数量
插件部分				
1	PCB	100*58*1.6mm/无铅锡板/2oZ/绿油白字/过孔盖油	/	1
2	连接器	5.08*2P	J5	1
3	连接器	XH2.54*4PIN 直插式公座	J10	1
4	短路帽	2.5*2P 短路 PIN+帽	JP1-6	6
5	固态电容	100uF35V 6.3*8	C1	1
6	测试点	测试点	TP1-13	13
贴片部分				
7	贴片电阻	1mΩ 1206 1%	R5	1
8	贴片电阻	10KΩ 0603 5%	R4	1
9	贴片电阻	16KΩ 0603 5%	R3	1
10	贴片 MOS	2N7002 SOT-23	Q1	1

Table 4. PD 小板 BOM 表

序号	物料名称	规格描述	位号	数量
插件部分				
1	PCB	32*22*1.2mm/无铅锡板/2oZ/绿油白字/过孔盖油	/	1
2	排针	2.54*7*2P 双排 7PIN 排针	J7	1
贴片部分				
3	贴片电阻	0Ω 0603 5%	R22.43	2
4	贴片电阻	5mΩ 1206 1%	R34	1
5	贴片电阻	2.2Ω 0603 5%	R29	1
6	贴片电阻	22Ω 0603 5%	R37.38.40.41	4
7	贴片电阻	510Ω 0603 5%	R33	1
8	贴片电阻	1KΩ 0603 5%	R31.21.27.25	4
9	贴片电阻	4.7KΩ 0603 5%	R28.30	2
10	贴片电阻	10KΩ 0603 5%	R23.24.36	3
11	贴片电阻	100KΩ 0603 5%	R35	1
12	贴片电容	330P50V X7R 0603	C37.38	2
13	贴片电容	223K50V X7R 0603	C33	1
14	贴片电容	103K50V X7R 0603	C32	1
15	贴片电容	474K10V X7R 0603	C34	1
16	贴片电容	105K50V X7R 0603	C30.31.36	3
17	贴片电容	225K10V X7R 0603	C35	1
18	MOSFET	CWT3122 DFN3*3-8	Q6	1
19	IC	HUSB350-QFN16	U3	1
20	贴片三极管	MMBT3906 SOT-23	Q3	1
21	连接器	TCR14-32111602-01	J8	1

Table 5. Type-A 小板 BOM 表

序号	物料名称	规格描述	位号	数量
插件部分				
1	PCB	32*22*1.2mm/无铅锡板/2oZ/绿油白字/过孔盖油	/	1
2	连接器	2.54*7*2P	J5	1
3	连接器	USB-A-4PIN	J6	1
4	固态电容	330uF16V 6.3*8	C16	1
5	电感	38125-0.65MM-33UH	L1	1
贴片部分				
7	贴片电阻	20mΩ 1206 1%	R16	1
8	贴片电阻	10Ω 0805 5%	R12	1
9	贴片电阻	100Ω 0603 5%	R13	1
10	贴片电阻	510Ω 0603 5%	R10	1
11	贴片电阻	1KΩ 0603 5%	R7,17	2
12	贴片电阻	30.9KΩ 0603 1%	R14	1
13	贴片电阻	33KΩ 0603 5%	R6	1
14	贴片电阻	43KΩ 0603 5%	R18	1
15	贴片电阻	49.9KΩ 0603 1%	R19	1
16	贴片电阻	100KΩ 0603 1%	R15	1
17	贴片电阻	1MΩ 0603 5%	R9	1
18	贴片电阻	2MΩ 0603 5%	R8	1
19	贴片电容	102K50V 0603 X7R	C14,15	2
20	贴片电容	104K50V 0603 X7R	C11,17,18	3
21	贴片电容	105K10V 0603 X7R	C10	1
22	贴片电容	106K35V 1206 X7R	C12,13	2
24	贴片 MOS	2N7002 SOT-23	Q2	1
25	IC	LM321 SOT-25	U1	1
26	IC	SP1231FL SO-8	U2	1

Table 6. DC-DC 小板 BOM 表

序号	物料名称	规格描述	位号	数量
插件部分				
1	PCB	32*21*1.2mm/无铅锡板/2oZ/绿油白字/过孔盖油	/	1
2	固态电容	100uF35V 6.3*8	C1D, C16	2
贴片部分				
3	贴片电阻	0Ω 0603 5%	R3,R10,R35	4
4	贴片电阻	4.7kΩ 0603 5%	R14	1
5	贴片电阻	1KΩ 0603 5%	R9,R13	3
6	贴片电阻	10KΩ 0603 5%	R2,R11, R12,R29,R30	6
7	贴片电阻	100KΩ 0603 5%	R27,R1,R7	4
8	贴片电阻	51KΩ 0603 5%	R5	2
9	贴片电阻	300kΩ 0603 5%	R6	1
10	贴片电容	330P50V X7R 0603	C14,C15	2
11	贴片电容	104K50V X7R 0603	C1C,C2D	4
12	贴片电容	105K35V X7R 0603	C4	5
13	贴片电容	226K35V X7R 0805	C2C,C2,C1,C1A	4
14	贴片电容	225K25V X7R 0603	C3	1
15	贴片电感	SPM10040T-4R7M 4.7UF, 6A	L1	1

16	稳压二极管	BZT52C15S SOD-323	ZD2,ZD3	5
17	贴片三极管	MMBT3906 SOT-23	Q1	1
18	IC	MP2491C QFN	U1	1

PCB LAYOUT

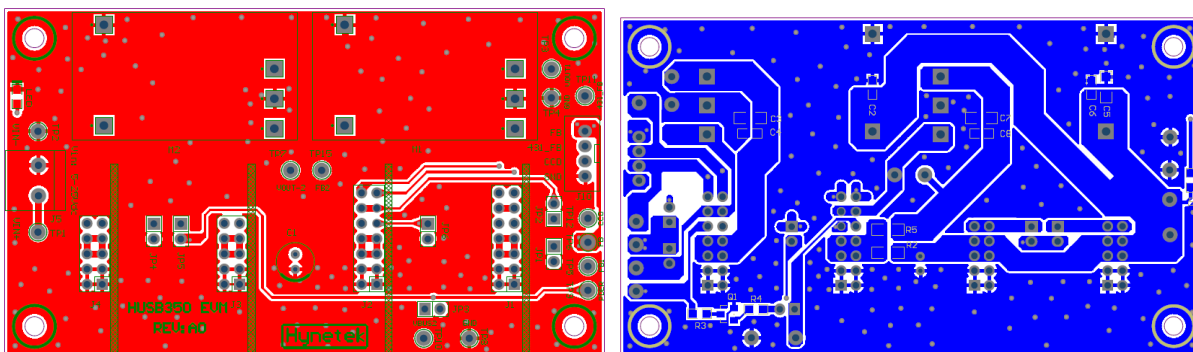


Figure 8. 主板 PCB 图

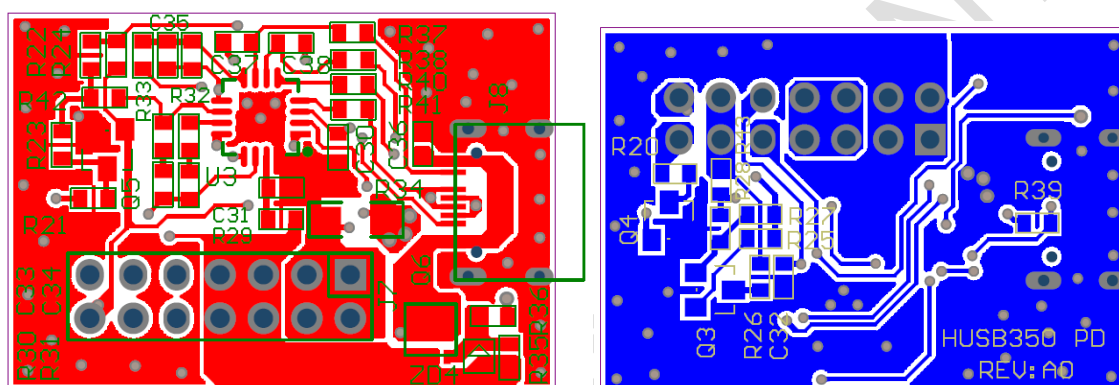


Figure 9. PD 小板 PCB 图

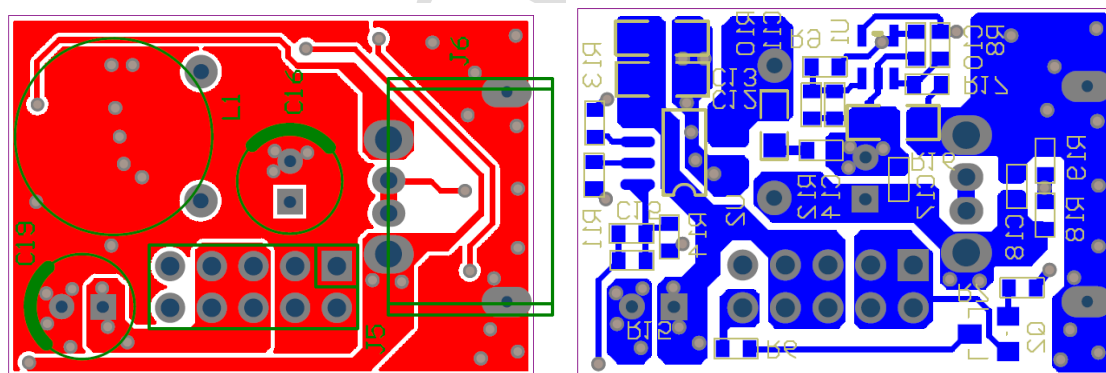
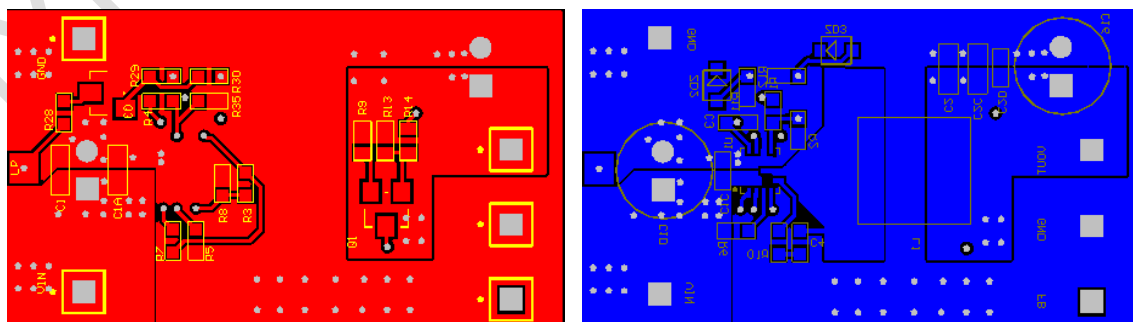


Figure 10. Type-A 小板 PCB 图



诱骗器广播信息



C1 口单独使用, C1 口广播信息



C1.C2.A1 同时使用, C1 口广播信息



C1&C2 同时使用, C1 和 C2 口广播信息

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