HUSB339 60W 双 C 口盲插智能功率分配方案参考设计

简介

慧能泰半导体 Hynetek 最新一代的 PD3.0 PPS 芯片 HUSB339 已经进入量产阶段，主要特点如下

- 中国大陆第一家通过 USB PD3.0 PPS 认证的芯片，TID 62。
- 支持多达五档 FPDO 和二档 APDO。支持 5V ~ 23V 范围内任意设置和组合 FPDO 档位，所有 PDO 的最大电流等级可达 5A。
- 自带 VCONN 电源和 USB 电子标签芯片（eMarker ）检测，支持最大 5A 、115W 大功率输出的单芯片 PD 协议方案。
- 支持灵活的双插任意降功率值。
- CC 引脚支持 28V 高压，有效保护 CC 脚与 VBUS 高压短路的风险。
- 支持通过 Type-C 口烧录。

慧能泰半导体制作了总功率为 60W 输出的双 C 口输出参考设计，该参考设计实现了双 C 口盲插智能功率分配功能。当其中任意一个 C 口接入负载时，广播并可以输出 60W 功率。当两路 C 口同时连接负载时，两路 C 口同时广播并可以输出 30W 功率，总功率一直保持 60W 输出。

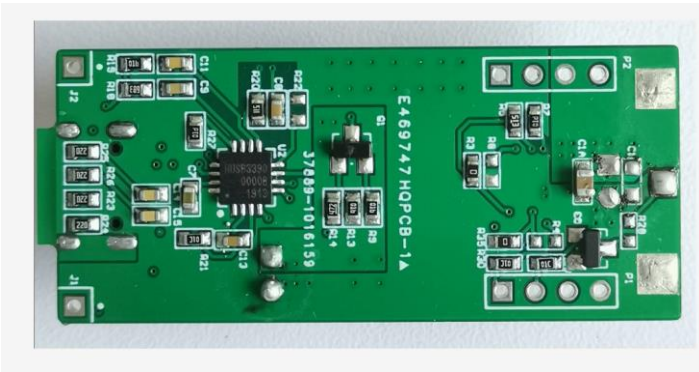


图 1.参考样机底视图

图 2. 参考样机顶视图

规格指标

参考设计的规格指标如表 1。

表 1. 设计板规格指标

类别	项目	规格指标
输入特性	输入电压范围	16V~20.5V
C1 口输出特性	充电协议标准	PD2.0, PD3.0, PPS, QC2.0,QC3.0, Apple 5V/2.4A, BC 1.2 DCP
	输出电压电流（单插 C1 口）	5V3A, 9V3A，12V3A，15V3A，20V3A
	输出电压电流（双口同插）	5V3A, 9V3A，12V2.5A，15V2A，20V1.5A
	输出功率（单插 C1 口）	60W
	输出功率（双口同插）	30W

C2 口输出特性	充电协议标准	PD2.0, PD3.0, PPS, QC2.0,QC3.0, Apple 5V/2.4A, BC 1.2 DCP
	输出电压电流（单插 C2 口）	5V3A, 9V3A，12V3A，15V3A，20V3A
	输出电压电流（双口同插）	5V3A, 9V3A，12V2.5A，15V2A，20V1.5A
	输出功率（单插 C2 口）	60W
	输出功率（双口同插）	30W

电路连接

参考板与 AC-DC 功率级连接参见图 3 所示。60W 双 C 的 PCB 板由两个相同的单 C 板连接而成，只需要设计一块 PCB layout 就可以实现该方案。同时，该方案可以智能调节母线电压，当输出电压低于 15V 时母线电压为 16V，当母线电压为 15V 及以上时输出电压为 20V，以此提高整机效率。

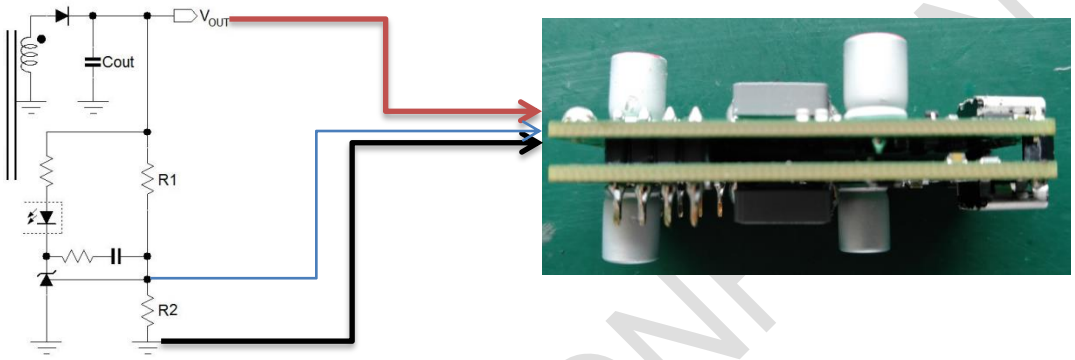


图 3. 参考设计的连接图

原理图

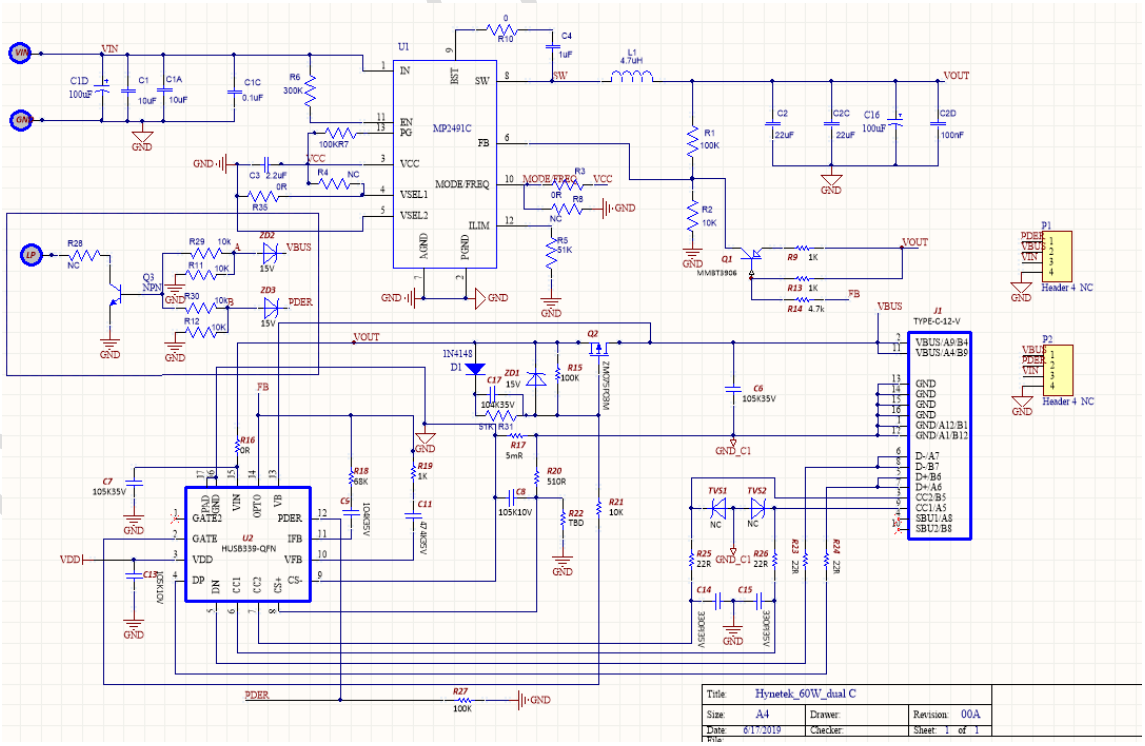


图 4. 参考设计的原理图

BOM 表

Table 2. 参考设计的 BOM 表

序号	物料名称	规格描述	位号	数量
插件部分				
1	PCB	48*20*1.2/2oZ/无铅锡板/绿油白字/过孔盖油	/	1
2	固态电容	100uF35V 6.3*8	C1D，C16	2
3	4 PIN 连接器	'Header, 4-Pin	P1, P2	2
贴片部分				
4	贴片电阻	0Ω 0603 5%	R16,R3,R10,R35	4
5	贴片电阻	5mΩ 1206 1%	R17	1
6	贴片电阻	22Ω 0603 5%	R23,R24,R25,R26	4
7	贴片电阻	4.7kΩ 0603 5%	R14	1
8	贴片电阻	510Ω 0603 5%	R20	1
9	贴片电阻	1KΩ 0603 5%	R9,R13,R19	3
10	贴片电阻	10KΩ 0603 5%	R2,R21,29,R30	3
11	贴片电阻	68KΩ 0603 5%	R18	1
12	贴片电阻	100KΩ 0603 5%	RR15,R27,R1,R7	4
14	贴片电阻	51KΩ 0603 5%	R5,R31	2
15	贴片电阻	300kΩ 0603 5%	R6	1
16	贴片电容	330P50V X7R 0603	C14,C15	2
17	贴片电容	104K50V X7R 0603	C9,C17,C1C,C2D	4
18	贴片电容	474K16V X7R 0603	C11	1
19	贴片电容	105K35V X7R 0603	C4,C6,C7,C8,C13	5
20	贴片电容	226K35V X7R 0805	C2C,C2,C1,C1A	4
21	贴片电容	225K25V X7R 0603	C3	1
22	贴片电感	IND-0730 4.7UF, 6A	L1	
23	二极管	1N4148WS SOD-323	D1	1
24	稳压二极管	BZT52C15S SOD-323	TVS1,TVS2,ZD1,ZD2,ZD3	5
25	MOSFET	CWT3122AP DFN3*3	Q2	1
26	IC	HUSB339-QFN	U2	1
27	贴片三极管	MMBT3904 SOT-23	Q3	1
28	贴片三极管	MMBT3906 SOT-23	Q1	1
29	IC	MP2491C QFN	U1	1
30	连接器	USB3.1C 16PF SMT 单排 2.0 版 板上母座	J1	1

PCB LAYOUT

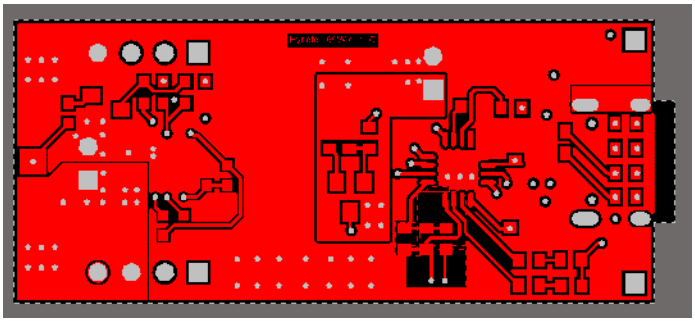


图 5. PCB 顶部图

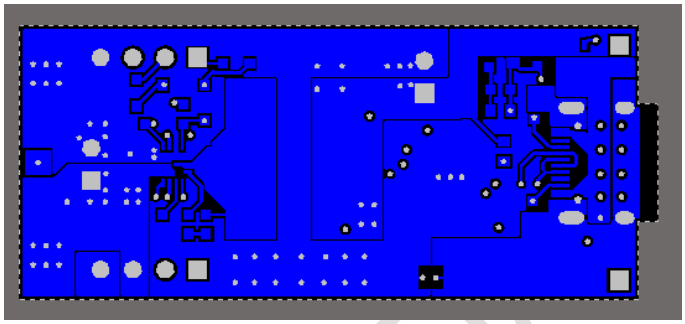


图 6. PCB 底部图

测试波形

图 7. 当只有一个 C 口插入时，广播 60W。

图 8. 当双 C 口同时插入时，两个 C 口都是广播 30W。

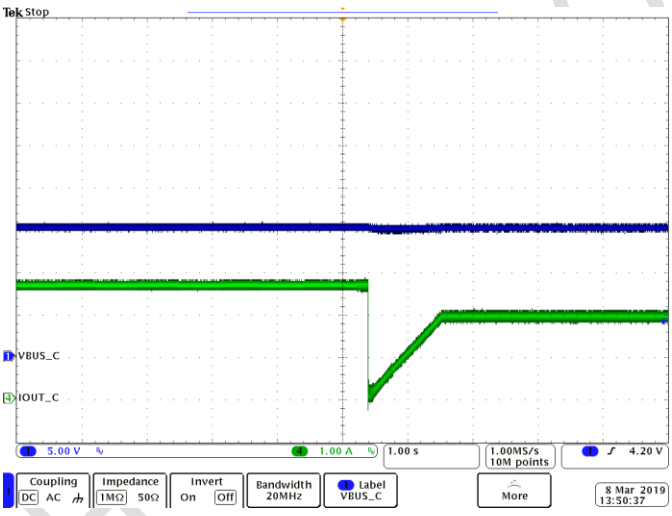


图 9.同时插入两个 C 口时，先插入 C 口会重新广播 30W 功率，期间输出电压 VBUS 不跌落。

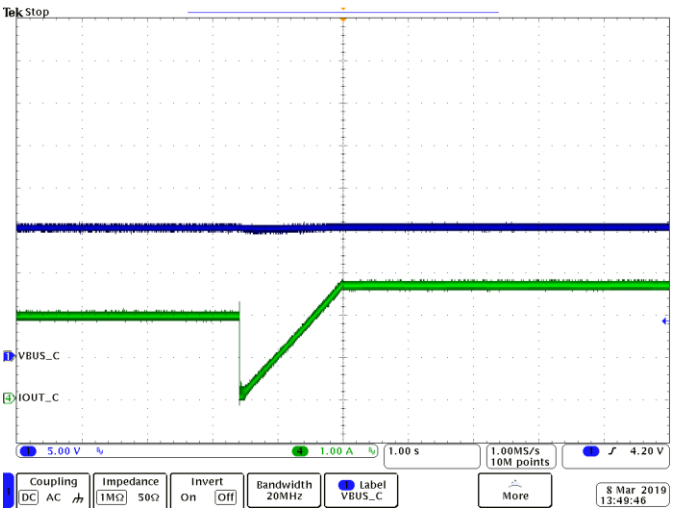


图 10. 两个 C 口同时插入，当拔出其中一个 C 口时，另一个 C 口会重新广播 60W 功率，期间输出电压 VBUS 不跌落。

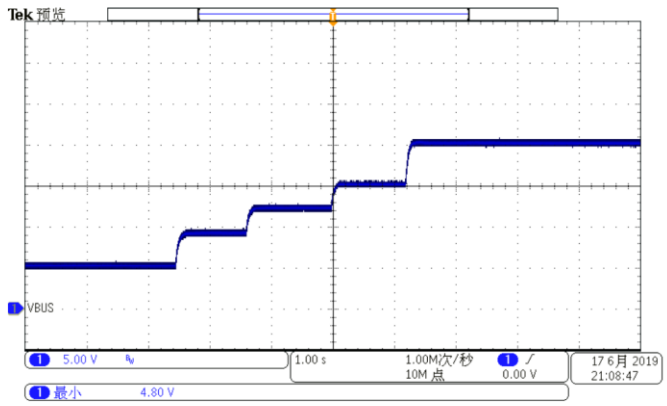


图 11.输出 5V~9V~12V~15V~20V 电压切换

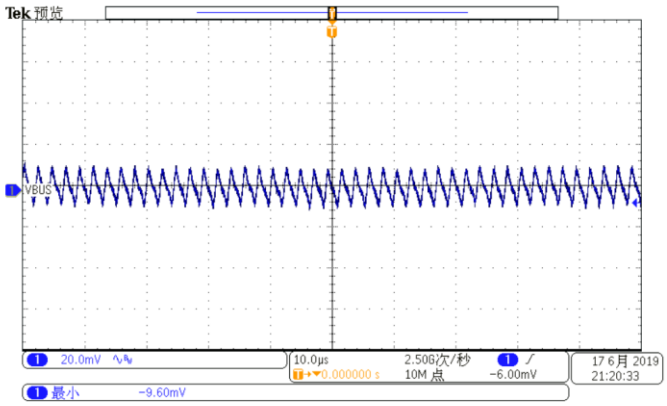
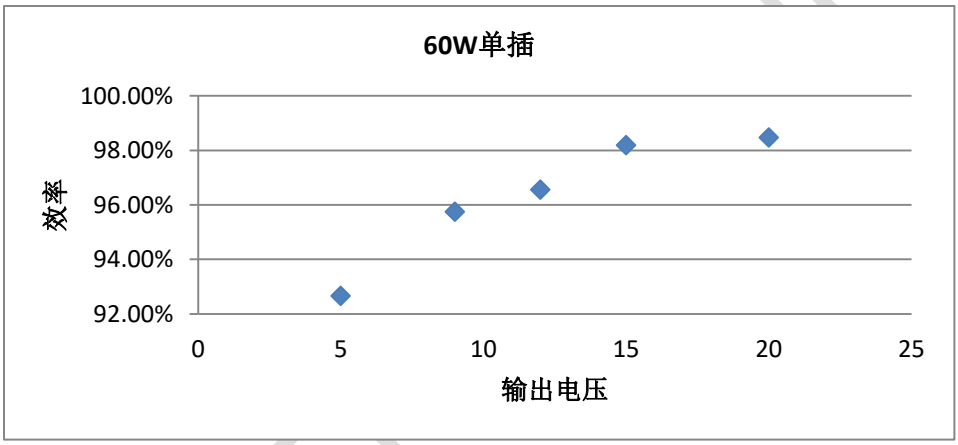


图 12. 20.5V 输入，输出 5V3A 时的输出纹波

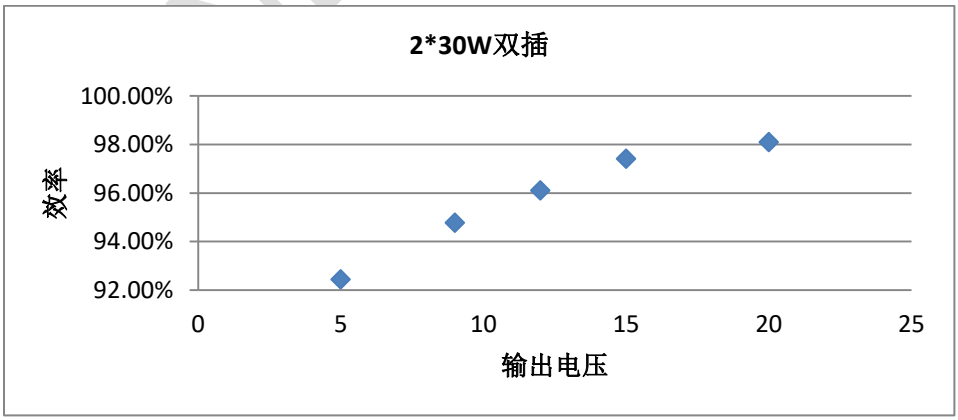
效率测试

静态功耗：36.8mW（20.5V 输入）。

单插 60W 输出: （单口输出 5V3A，9V3A, 12V3A, 15V3A, 20V3A，输出低于等于 15V 时输入 16V,输出大于 15V 时输入 20.5V)

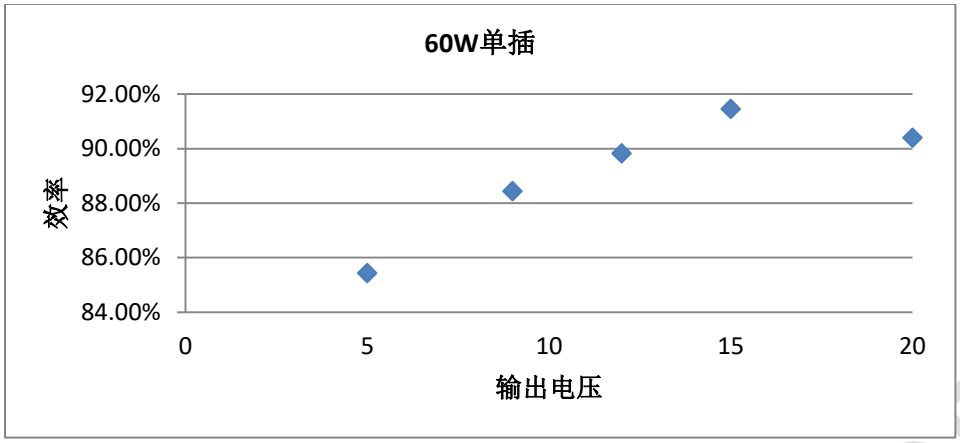


双插 2*30W 输出： (双口均输出 5V3A，9V3A，12V2.5A, 15V2A, 20V1.5A, 输出低于等于 15V 时输入 16V,输出大于 15V 时输入 20.5V)

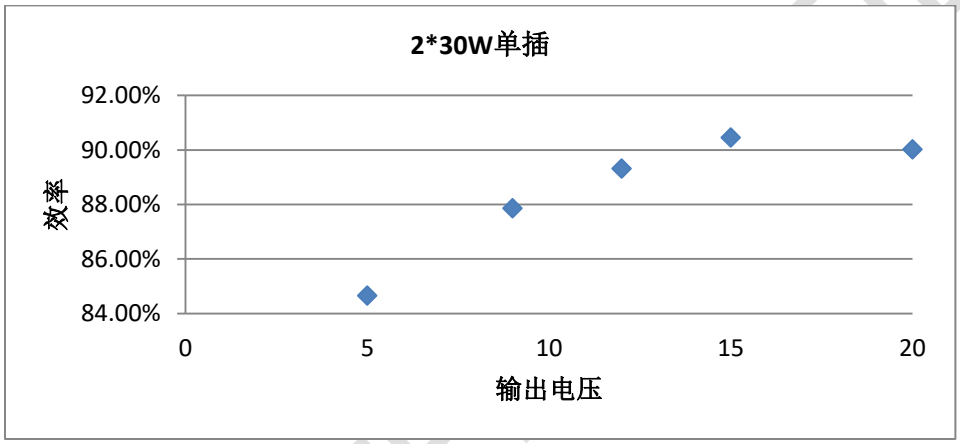


搭配 PI SC1933C AC-DC 效率测试

单插 60W 输出: （220V 输入，单口输出 5V3A，9V3A, 12V3A, 15V3A, 20V3A）



双插 2*30W 输出： （220V 输入，双口均输出 5V3A，9V3A，12V2.5A, 15V2A, 20V1.5A）



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