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AN-6102

USB Type C, CC 引脚保护

使用齐纳二极管保护 A 至 C 高压充电器应用的 CC 引脚

当使用连接 USB Type A 与 USB Type C 的电缆时，该电缆包含位于 V_{BUS} 到 CC 引脚之间的 R_p 上拉电阻，这

样做是为了 Type C 设备可以检测插头的正确方向，图 1 显示连接 Type A 与 Type C 的电缆示例。

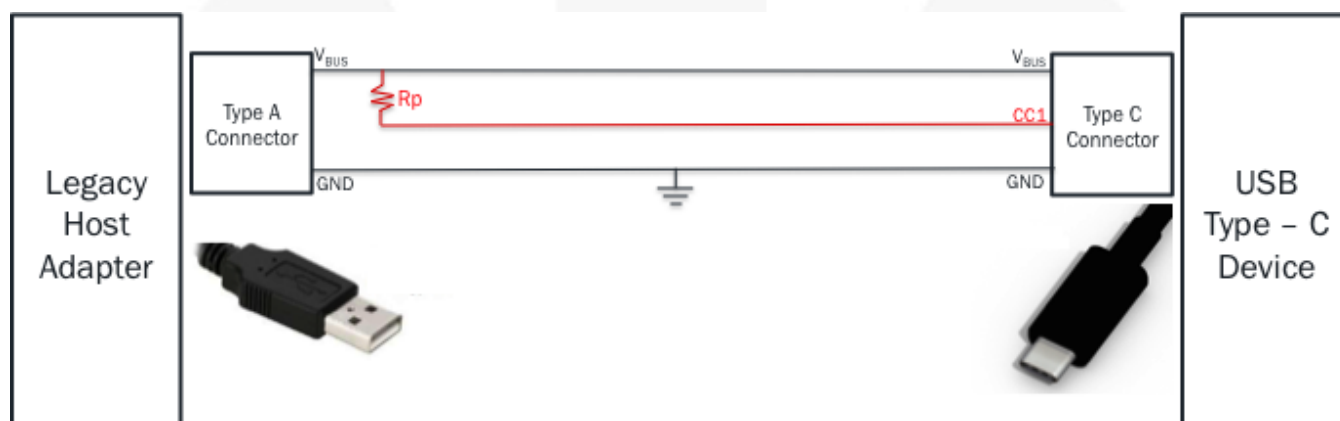


图 1. 连接 Type A 与 Type C 的电缆示例

利用此电缆，Type C 设备便可以向后兼容现有设备。但是，有一些包含快速充电协议的电源适配器使用 Type A 连接器进行快速充电。当最终用户使能现有的快速/高压充电时， V_{BUS} 可以增加至 20 V，这将导致 CC 引脚的电压也增加到超出设备的绝对最大额定值。要计算 CC 引脚上可以出现的最大电压，请使用等式 (1)。

$$V_{CC} = V_{BUS} * \left(\frac{R_d}{R_p + R_d} \right) \quad (1)$$

在设备上使能 R_d 后，可以使用 5.1 k 的 R_d ，且需要确定 R_p 才能计算 CC 上存在的电压。假定最差情况，我们将在 20 V V_{BUS} 下使用 4.7 k Ω R_p 。我们可以看到 V_{CC} 可高达 10.4 V，CC 引脚的绝对最大额定值为 6 V，因此可以利用齐纳二极管箝位电压以保护 CC 引脚。但是，由于 CC 引脚用于 Type C 和 PD 通信，因此必须选择正确的箝位电压才能防止通信故障。优先选择大于 5 V 小于 6 V 的箝位电压。表 1 显示两个需要满足这些要求的齐纳二极管零件编号 (5.1 V 和 5.6 V)。

表 1 齐纳二极管示例

制造商	制造商零件编号	电压 – 齐纳(Nom) (V_z)	容差	功率 - 最大值 (P_d)	反向电流泄漏 (I_r)
Bourns	CD1005-Z5V1	5.1 V	5%	200 mW	100 nA
Comchip	CZRF52C5V6	5.6 V	5%	200 mW	100 nA

选择要使用的齐纳二极管时，注意事项之一是查看齐纳二极管功耗额定值。在激活齐纳二极管后，可通过VBUS 电压和 R_p 值计算最大电流，如果二者分别为 20 V 和 4.7 k Ω ，将得出通过 R_p 电阻的电流为 4.26 mA，齐纳二极管将需要耗散 85 mW 的功率才能保

护设备。要使此保护生效，关键是选择正确的齐纳二极管，由于推荐的 2 个齐纳二极管的最大功率额定值为 200 mW，根据 200 pF（最小值）到 600 pF（最大值）的 PD 规格接收器要求，其电容应不超过 600 pF。

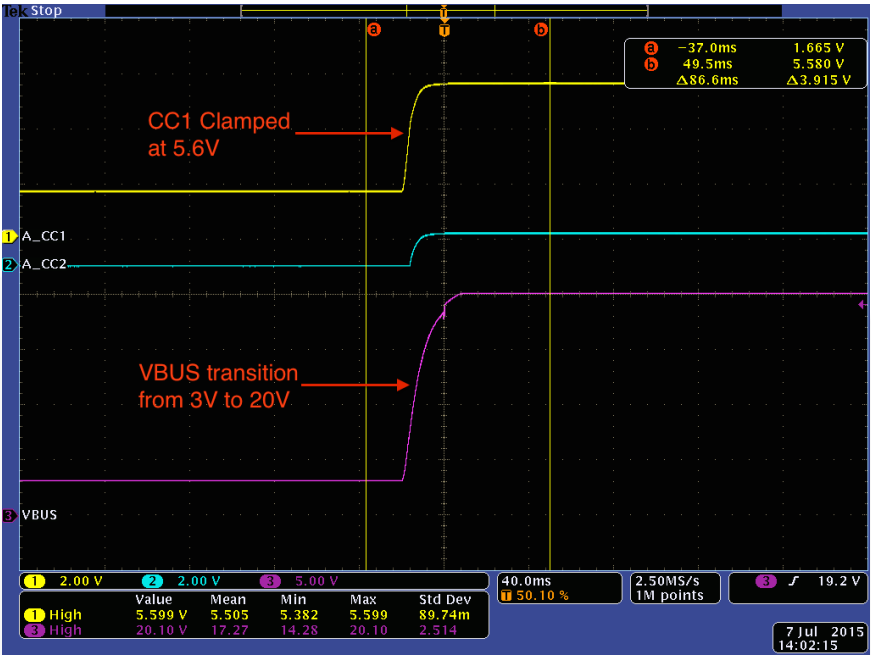


图 2. CC 上的 5.6 V 齐纳二极管

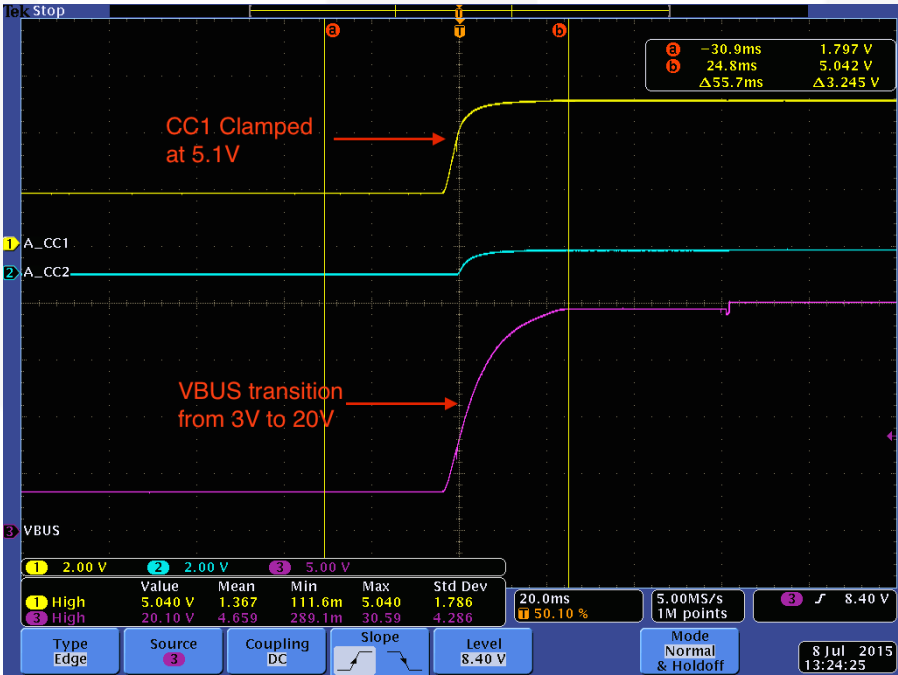


图 3. CC 上的 5.1 V 齐纳二极管

FUSB302 参考原理图

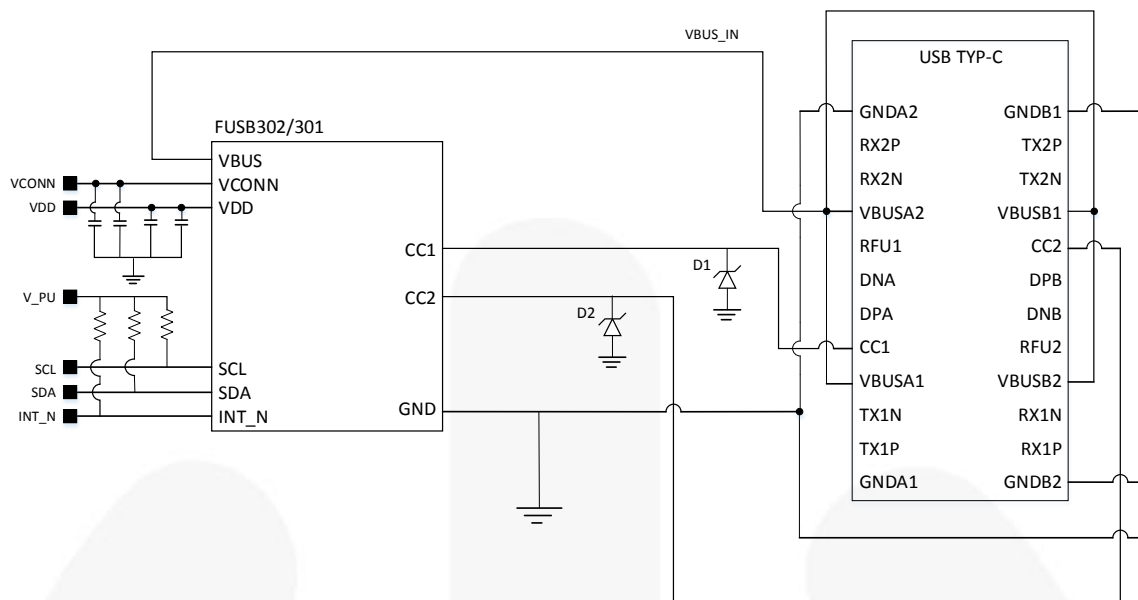


图 4. 参考原理图

说明:

1. 建议将齐纳二极管放置在尽可能靠近设备的位置。

相关数据手册

[FUSB300C — 可编程 USB Type-C 控制器](#)

[FUSB301 — 数据表概述](#)

[FUSB301A—Autonomous USB Type-C Control with Configurable I²C Address](#)

[FUSB302 — 带 PD 的可编程 USB Type-C 控制器](#)

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