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USB Type-C™ is upon us, representing the most significant change to USB that most consumers will notice to date. On top of a new reversible connector, the maximum power has increased to 15W. Higher wattage makes it difficult to design power adapters that meet the required efficiency and standby power standards while maintaining the small form factor that customers expect. But it is not impossible, since new flyback controllers such as the [UCC28704](#), which TI released earlier this year, further improve performance and include many advanced features for USB Type-C chargers.

CCUV

All short-circuit protection is not equal. While most controllers protect against hard short-circuit events, where the output current attempts to run far away from the set limit, they do not protect against soft short-circuit failures. When dust or other foreign objects get into the small USB connector and short across the power leads, the connector bypassing current charging path, so-called the soft short-circuit occurs, causing the converter to operate in faulty pathed over-load current that overheats then damages the USB connector in soft short-circuit. Constant Current Output Under Voltage (CCUV) shutdown provides soft short-circuit fault detection and protection to prevent damaging the USB connector. CCUV operation and characteristics are illustrated in [Figure 1](#) and [Figure 2](#).

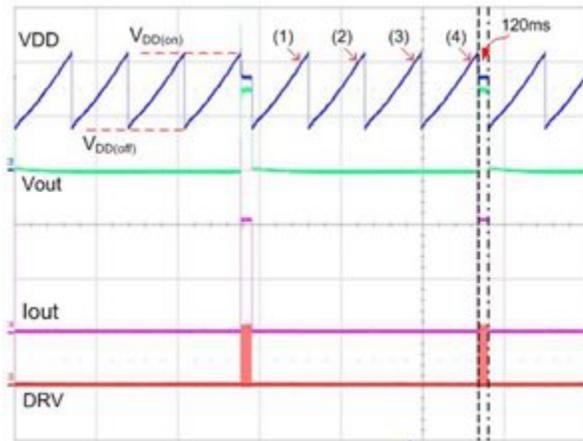


Figure 1. Soft-short Protection

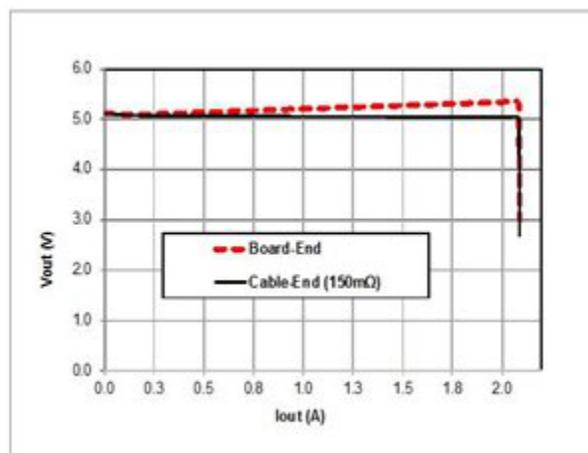


Figure 2. Output v -1 Curves

Efficiency Boost

The Department of Energy (DoE) Level VI (mandated) and European Union Code of Conduct (CoC) V5 Tier 2 standards set up the efficiency and standby power consumption levels for USB Type-C chargers.

To meet and exceed these standards, the UCC28704 has these enhancements:

- An increased maximum demagnetizing time ratio (Dmag) to 0.475. This increase mainly helps reduce secondary-side peak current and RMS current for the same rated output current to boost efficiency. This helps to achieve higher efficiency at heavy (75%) and full (100%) loads.
- Two techniques boost efficiency at 10%, 25% and 50% loads:
 - Enabling light to medium load-switching frequency at about 25kHz to reduce switching losses while avoiding audible noise.
 - The introduction of a “wait” state to shut off internal unused circuits, thus reducing the device’s bias energy at light to medium loads.

As [Table 1](#) shows, the UCC28704 in [TI Designs Universal AC Input to 5V 3A Output Reference Design DOE VI and CoC V5 Tier 2 2016 Compliant \(PMP15002\)](#) can meet these standards with a 150mΩ cable, while passing both conducted and radiated electromagnetic interference (EMI) while not sacrificing size or cost. These benefits are not limited to 15W, and as [TI Designs Universal AC Input to 5V 2A Output Reference Design CoC Tier 2 2016 Compliant \(PMP11612\)](#) shows, the UCC28704 can achieve the same high performance at 10W as well. By enabling such high efficiency, the latter reference design meets DoE Level VI and CoC V5 Tier 2 efficiency with a diode on the output, enabling a very low-cost solution, which reducing the cost from where an SR MOSFET with driver device has to be used in alternative solutions.

Table 1. TI’s PMP11612 and PMP15002 Reference Designs Exceed Mandated DoE and CoC Levels (Efficiency Is the Average Value of Four-point Efficiency at 25%, 50%, 75% and 100% Loads)

Converter specs	Four-point average efficiency			
	DoE Level VI	CoC V5 Tier 2	PMP11612	PMP15002
10W, 5V	≥78.7%	≥79.0%	80.5%	N/A
15W, 5V	≥81.4%	≥81.8%	N/A	82.6%
150mΩ cable end				

Besides the reference designs, other design tools available on the UCC28704 product page include a [SPICE model](#), [WEBENCH® Designer calculator](#), [Excel calculator](#), [MathCAD calculator](#), [UCC28704EVM-724 evaluation module](#) and a [user’s guide](#).

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