Reference Design For Compact USB Type-C 27-W Power Adapters

STMicroelectronics' STEVAL-USBPD27S is a USB Type-C Power Delivery 3.0 reference design with programmable power supply (PPS). It supports the design of compact, and efficient power adapters up to 27 W with zero-power operation when no cable is connected. USB PPS helps to save power, and reduce device-charging times and heat dissipation, contributing also to cut bill-of-materials costs on the device side (see the figure).

The STEVAL-USBPD27S reference design combines the STM32G071 microcontroller (MCU), which integrates a complete USB Type-C Power Delivery controller on-chip, with the STCH03 PWM controller and the TCPP01-M12 USB Type-C protection IC. According to the vendor, with this reference design, users can quickly build fast-charging USB power adapters that meet the stringent European CoC version 5 Tier-2 and U.S. DOE Level VI requirements for minimum four-point average efficiency in active mode and standby power below 40 mW.

The STM32G071 MCU handles the entire digital control section, including the algorithm to control VBUS on the secondary side as well as ST's patented algorithm for adaptive synchronous rectification, which enhances energy efficiency.

The VBUS-control algorithm meets the USB Type-C Power Delivery and PPS specifications and implements cable-drop compensation for precise control of the supplied voltage. PPS support enables the output voltage to be adjusted in 20-mV steps between 3.3 V and 11 V, as well as current limiting adjustment in 50-mA increments, to minimize conversion losses during charging.

As an MCU-based solution, the reference design gives users extra flexibility to implement additional customized application layers and to incorporate ongoing improvements as the USB Power Delivery standard evolves.

The power section of the STEVAL-USBPD27S leverages ST's highly integrated STCH03 PWM controller, which features built-in high-voltage start-up circuitry, primary-side constant-current output regulation, and advanced power management. Designed for quasi-resonant ZVS flyback converters, the STCH03 ensures high efficiency, ultra-low standby consumption, and excellent dynamic performance, according to the vendor. The company also comments that the STD7N65M6 MDmesh M6 primary-side high-voltage STPOWER MOSFET delivers extremely high efficiency with optimized switching behavior in hard- and soft-switching modes.

Finally, the TCPP01-M12 provides ±8-kV ESD protection for the USB VBUS and Configuration Channel (CC) lines, meeting IEC 61000-4-2 Level 4. There is also short-circuit protection between the VBUS pins and CC lines and protection to prevent equipment damage if a defective cable is inserted. Delivered as a turnkey evaluation module in a 59-mm x 35-mm x 21-mm outline with a power density of 10.2 W/in.^{3}, the STEVAL-USBPD27S is available now for $95.00. For more information, see the STEVAL-USBPD27S page.

Figure. The STEVAL-USBPD27S 27-W ac-dc adapter reference design works as a USB Power Delivery provider with a single USB Type-C port supporting Programmable Power Supply (PPS) and featuring adaptive synchronous rectification. The reference design accepts a wide range of input voltages and delivers two well regulated fixed PDOs (5 V at 5 A, 9 V at 3 A) and two APDOs (5 V prog at 5 A and 9 V prog at 3 A), finely adjusted to the advertised voltage range (PPS), thus managing the V_{CONN}, as requested by the USB PD specification.