

Compact 27W USB Type-C™ Power Delivery 3.0 with PPS adapter reference design



Features

- USB Power Delivery 3.0 Compliant
- Universal input mains voltage range: 90 VAC to 264 VAC (line frequency: 45 Hz to 65 Hz)
- PD Output
 - Two fixed PDOs: 5V@5A, 9V@3A
 - Two APDOs (PPS): 5VProg@5A, 9VProg@3A
- PPS Mode: 20 mV step for CV, 50 mA step for CC
- Output Power: 27 W
- Minimum four-point average efficiency in active mode compliant with CoC ver. 5 – Tier 2 and DOE Level VI requirement
- < 40 mW no-load standby power
- Adaptive Synchronous Rectification controlled by on-board MCU
- Load feed-forward
- OVP, UVP, OC, short-circuit protections
- ESD Protection exceeding IEC61000-4-2 Level 4 on CC lines
- Immunity against surge current on VBUS pin up to 35 A in a 8/20 μ s waveform, according to IEC61000-4-5
- Compliant with EN55022 (Class B) standard for conducted noise emissions
- Compact form factor:
 - 59x35x21mm dimensions
 - 10.2 W/inch³ power density
- RoHS compliant

Description

The STEVAL-USBPD27S 27 W AC-DC adapter reference design works as USB Power Delivery Provider with a single USB Type-C port supporting Programmable Power Supply (PPS) and featuring adaptive synchronous rectification. Thanks to a minimal bill of materials, it allows users to easily design compact and cost-effective adapters.

The reference design accepts a wide range of input voltage and delivers two well regulated fixed PDOs (5V@5A, 9V@3A) and two APDOs (5VProg@5A and 9VProg@3A), finely adjusted to the advertised voltage range (Programmable Power Supply or PPS), thus managing the V_{CONN} , as requested by the USB Power Delivery specification.

The adapter meets the most stringent energy saving recommendations (EU CoC – Tier 2 ver. 5 and DOE Level VI) ensuring < 40mW of no load power consumption. All PDOs are compliant with CoC ver. 5 – Tier 2 and DOE Level VI requirements except the 9VProg@3A APDO, guaranteeing the compliance with the minimum four-point average efficiency in active mode.

The system has been tested to verify conducted noise emissions and compliance with the EN55022 (Class B) using standard average detectors, at half and full load with input voltage of 115 V_{AC} and 230 V_{AC} .

Summary table	
Compact 27W USB Type-C™ Power Delivery 3.0 with PPS adapter reference design	STEVAL-USBPD27S
Offline PWM controller for low standby adapters	STCH03
Mainstream Arm Cortex-M0+ MCU with 128 Kbytes of Flash memory, 36 Kbytes RAM, 64 MHz CPU, including USB Type-C and Power Delivery Interface	STM32G071KB
N-channel 650 V, 0.91 Ohm typ., 5 A MDmesh M6 Power MOSFET	STD7N65M6
USB type-C port protection	TCPP01-M2
Compact in-circuit debugger and programmer for STM32	STLINK-V3MINI
Software package for STEVAL-USBPD27S	STSW-USBPD27SFW

1 Design overview

The architecture is based on three main stages: the power supply stage implementing a QR fly-back topology based on the **STD7N65M6** MDmesh™ M6 primary MOSFET, the power control stage embedding the **STCH03** primary side PWM controller, and the digital control stage based on the **STM32G071KB** Arm Cortex-M0+ MCU that manages the USB Power Delivery stack, controls the USB Type-C connector, enables the V_{BUS} and the V_{CONN} power paths and runs the adaptive synchronous rectification algorithm.

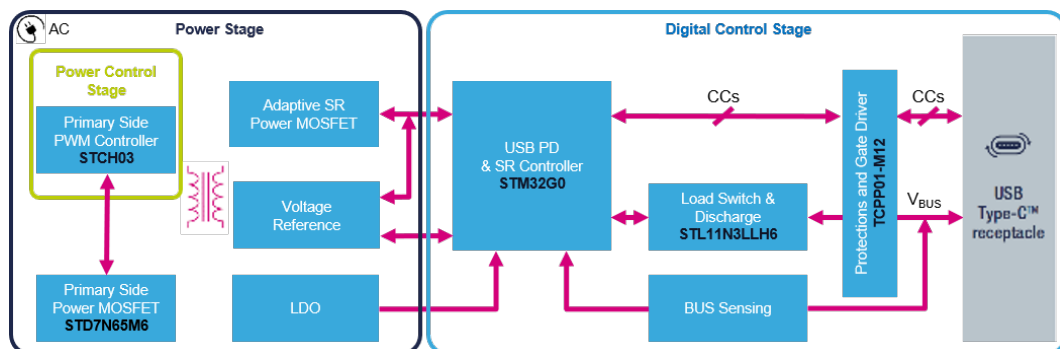
The USB-PD 3.0 Middleware stack, coming from the STM32CubeG0 package, runs over the STM32G071KBU6N.

On the primary side, the STCH03 controller combines a high performance low-voltage PWM controller chip with a 650 V HV start-up cell in the same package, ensuring low pin count. It can operate in different modes, QR active mode, valley skipping mode and burst mode, to guarantee high efficiency at different input voltage and output load conditions.

On the secondary side, the STM32G0 provides additional integration value, thanks to the embedded UCPD interface which manages the USB Type-C connector and the Power Delivery 3.0 communication protocol, while controlling the adaptive synchronous rectification through its versatile peripherals and feature set.

The companion **TCPP01-M2** safely interfaces the USB-C connector to the MCU, ensuring the highest robustness and protecting against any destructive electrostatic discharge (ESD). It features 22 V tolerant ESD protection as per IEC61000-4-2 level 4 on USB type-C connector configuration channel (CC) pins. The ESDA15P60 ensures ESD protection higher than 30 kV on the V_{BUS} .

Figure 1. Block diagram



Revision history

Table 1. Document revision history

Date	Version	Changes
03-Nov-2020	1	Initial release.
06-Nov-2020	2	Updated cover image.

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