

45 W USB Type-C™ Power Delivery adapter reference design based on STCH03, STM32F051 and STUSB1602A



Features

- USB PD 3.0 compliant
- Universal input mains voltage range: from 90 V_{AC} to 264 V_{AC} (frequency from 45 Hz to 65 Hz)
- Three fixed PDOs available: 5 V, 9 V, 15 V – 3 A continuous operation
- Load power limited to 45 W
- Minimum four-point average efficiency in active mode compliant with CoC ver. 5 – Tier 2 and DOE requirement
- Efficiency > 50% with P_{out} = 250 mW
- < 35 mW no-load standby power
- Adaptive synchronous rectification with digital driver and controller
- Load feedforward
- OVP, UVP, OC, short-circuit protections
- ESD protection: > 30 kV contact on VBUS and 20 kV contact on CC lines and according to IEC61000-4-2
- Immunity against surge current on VBUS pin up to 35 A in a 8/20 μs waveform, according to IEC61000-4-5
- Compact design: 73x51x25 mm
- RoHS compliant

Description

The **STEVAL-USBPD45C** 45 W AC-DC adapter reference design features a USB Type-C connector and functions as a USB Power Delivery provider with a single source port.

The reference design accepts a wide input mains range and delivers 5 V, 9 V and 15 V output voltage profiles, according to the Source Power Rules of the current USB Power Delivery specification.

The adapter architecture is based on two boards: the **STEVAL-USBPD45P** power supply board implementing the power stage in flyback topology with synchronous rectification, and the **STEVAL-USBPD45I** Digital Control Board designed to control the USB Type-C connector and manage the USB Power Delivery stack and the adaptive synchronous rectification algorithm.

The flyback converter is based on the **STCH03** offline PWM controller for low standby adapters and the **STF7N80K5** MDmesh™ K5 primary MOSFET.

On the secondary side, the adaptive synchronous rectification with **STL40N75LF3** Power MOSFET is controlled and driven directly by the **STM32F051** MCU, allowing an overall efficiency improvement with a very low external component count.

The USB type-C port is controlled by the certified **STUSB1602A**, enabling the VBUS power path and integrating high voltage protections on VBUS and CC lines.

Product summary

STEVAL-USBPD45C 45 W USB Type-C Power Delivery adapter reference design

STF7N80K5 very high voltage N-channel Power MOSFETs designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure

STL40N75LF3 N-channel enhancement mode Power MOSFET produced using STMicroelectronics' STripFET™ III technology

STUSB1602A USB Type-C controller (with Tx/Rx line driver and BMC)

STM32F051 high performance 32-bit ARM Cortex-M0 MCU

X-CUBE-USB-PD X-CUBE-USB-PD software expansion for STM32Cube

STSW-USBPD45CFW SW package for STEVAL-USBPD45C reference design

STCH03 Offline PWM controller for low standby adapters

1 Description continued

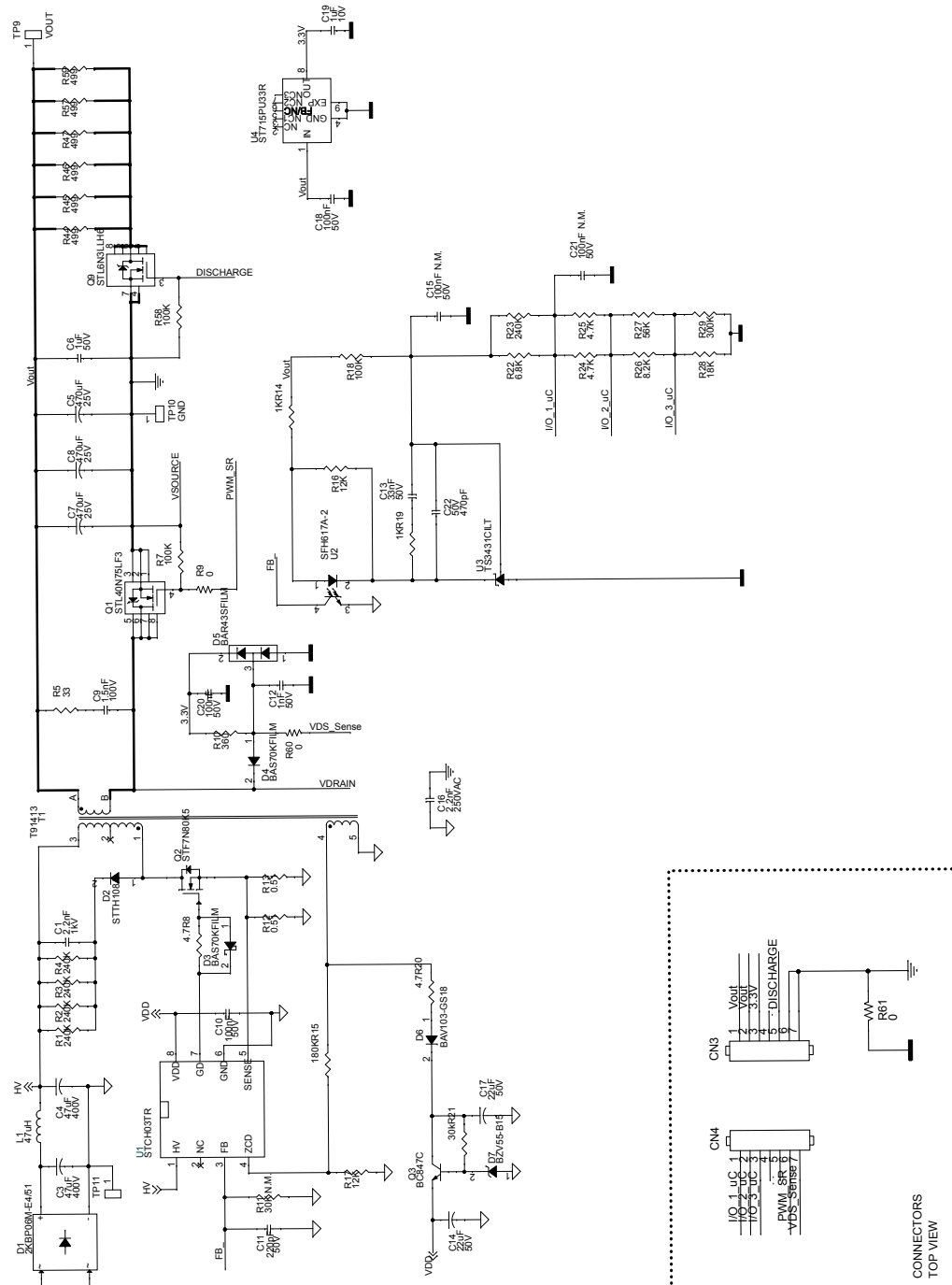
The [STUSB1602A](#) also integrates VBUS monitoring and discharge path features for further external component count reduction. The chipset ([STM32F051](#) + [STUSB1602A](#)) and relative stack [X-CUBE-USB-PD](#) running on STM32 are PD 3.0 certified.

The adapter is protected against any destructive electrostatic discharge (ESD) from the USB Type-C connector by an ESDA25P35-1U1M ESD protection device which exceeds the IEC61000-4-2 Level 4 standard, offering ESD protection higher than 30 kV on the VBUS pin. This protection also provides surge immunity against electrical over stress (EOS) to prevent damage to the internal circuitry by offering up to 35 A 8/20 μ s protection, as per the IEC61000-4-5 standard.

The adapter is designed to meet the most stringent energy saving recommendations (EU and DOE CoC ver. 5 - Tier 2).

2 Schematics diagram for STEVAL-USBPD45P

Figure 1. STEVAL-USBPD45P circuit schematic



3 Schematics diagram for STEVAL-USBPD45I

Figure 2. STEVAL-USBPD45I MCU section

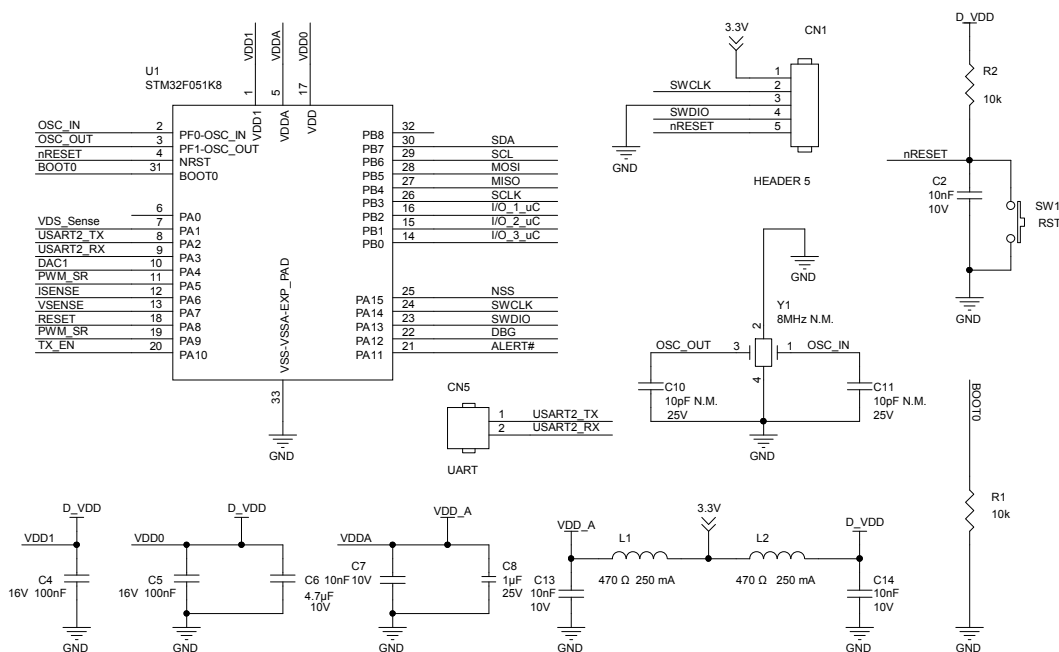


Figure 3. STEVAL-USBPD45I - STUSB1602A USB Type-C controller

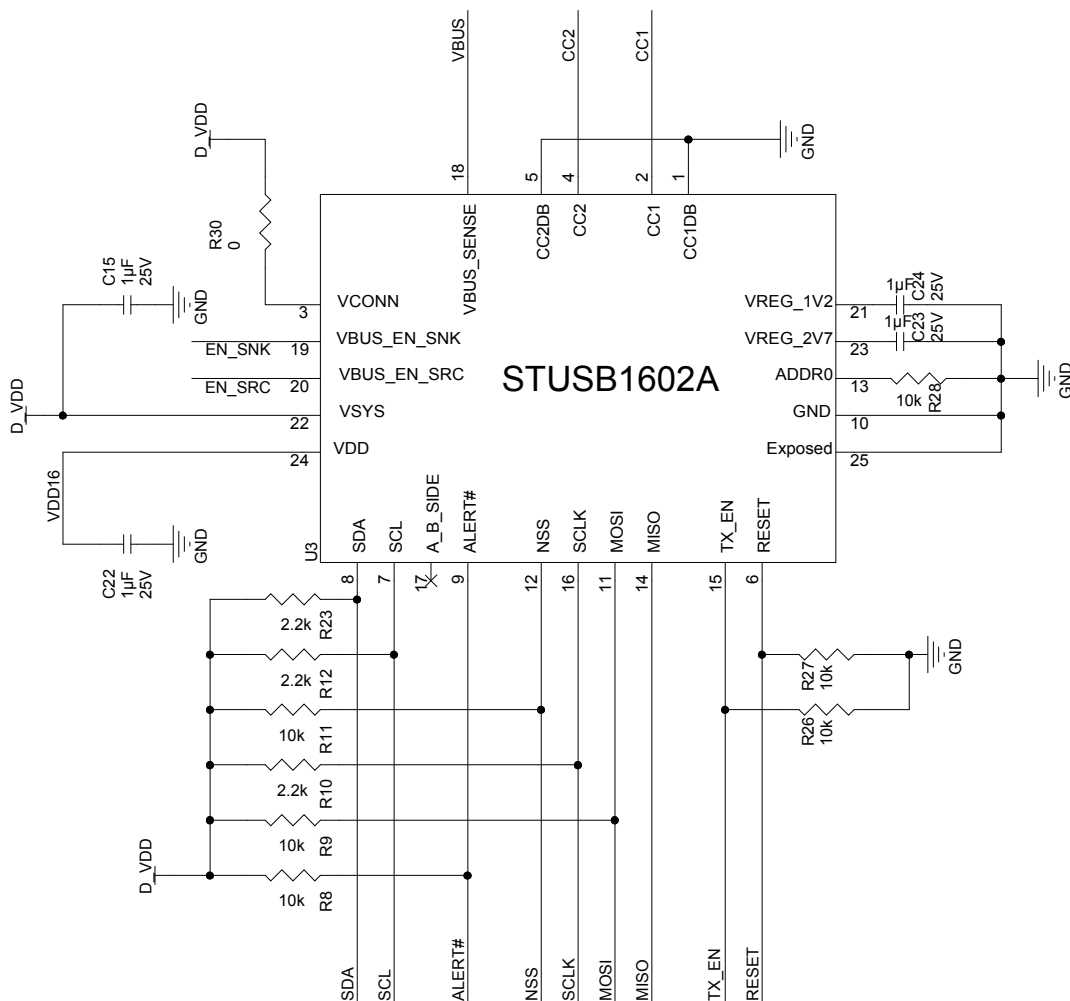


Figure 4. STEVAL-USBPD45I Type-C receptacle

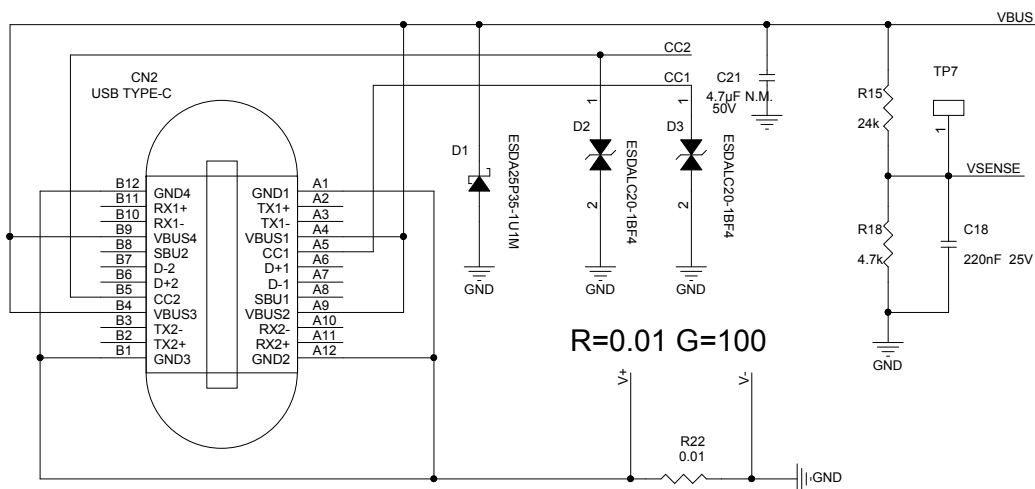


Figure 5. STEVAL-USBPD45I load switch & discharge driver

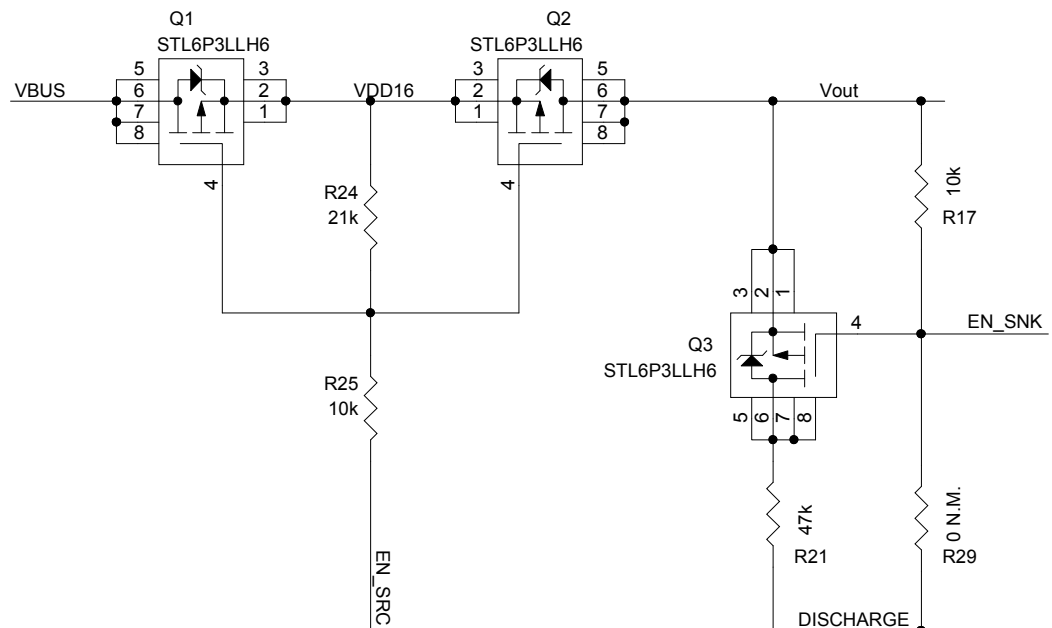


Figure 6. STEVAL-USBPD45I current sensing stage

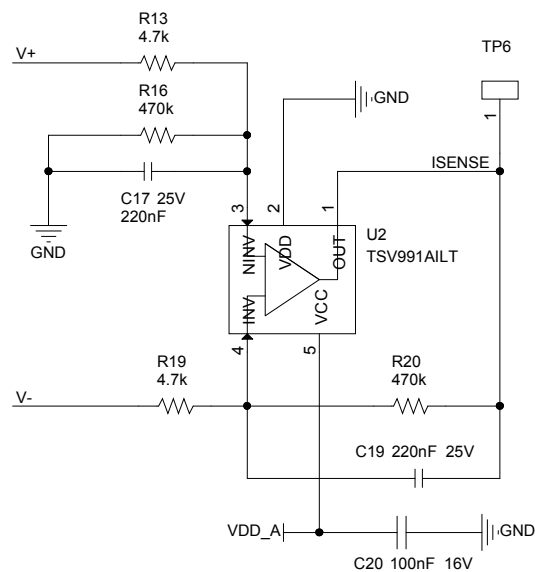


Figure 7. STEVAL-USBPD45I PSB interface connector

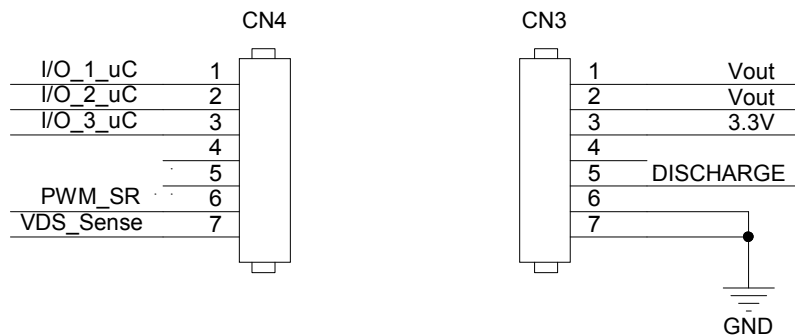
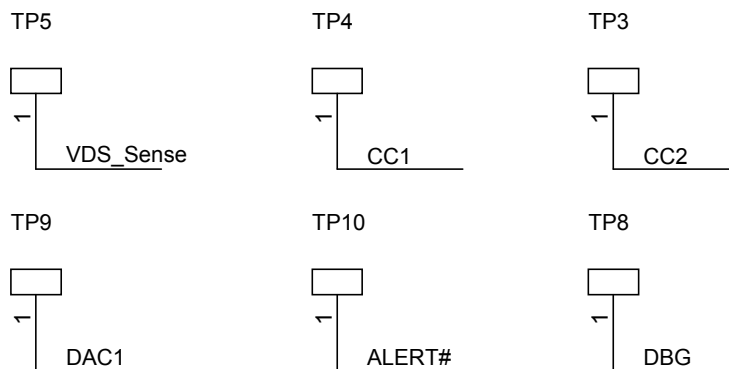


Figure 8. STEVAL-USBPD45I test points



Revision history

Table 1. Document revision history

Date	Version	Changes
10-May-2018	1	Initial release.
04-Jul-2018	2	Minor text edits
20-Feb-2019	3	Updated navigation links

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2019 STMicroelectronics – All rights reserved