



System Solution Guide - Preview

USB-C Battery Charger



onsemi.com



Table of Contents

Get Latest
Version

Overview

Applications	03
System Purpose	04

Market Information & Trend

USB-C Battery Charger Market Outlook, Extended Power Range & Types	05
Faster Data Transfer Capabilities, Protocol Compatibility, GaN Technology	06

System Implementation

Architectures and Main Stages	07
-------------------------------	----

System Description

USB Type-C Pinout Configuration & USB-C PD specification	08
AC-DC Power Conversion & PD Control	09

Solution Overview

Block Diagram - USB-C Battery Charger	10
USB-C PD Charger Reference Designs	11
Topologies	13
650V GaN HEMT with Integrated Driver (iGaN)	14
T10 LV-MV MOSFETs	15
Super-junction (SJ) MOSFETs	16
PFC Controller NCP1680	17
QR Flyback Controller NCP1345	19
USB PD Controller FUSB302	20

Recommended Products

22

onsemi™

onsemi

System Solution Guide
USB-C Battery
Charger

Register now to unlock all System Solution Guides



1



2



3



4



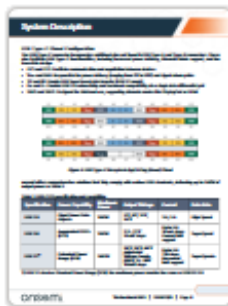
5



6



7



8



9



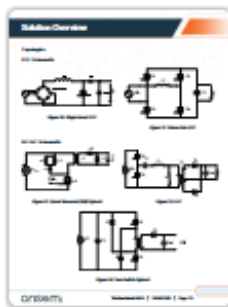
10



11



12



13



14



15



16



17



18



19



20

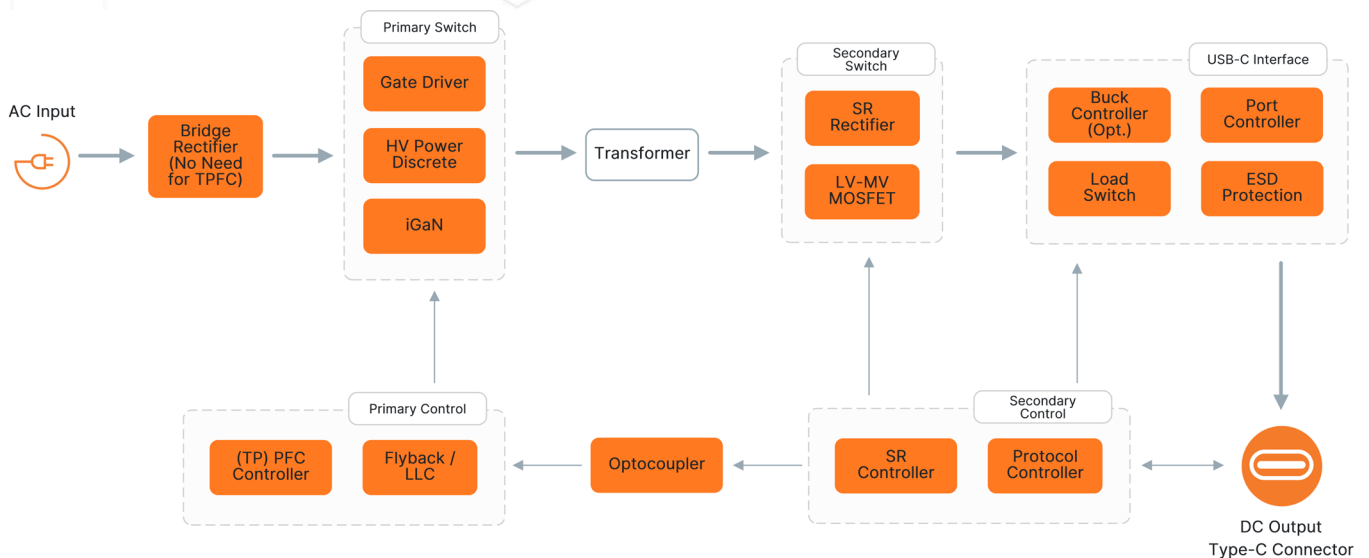
Block Diagram - USB-C Battery Charger

Get Latest
Version

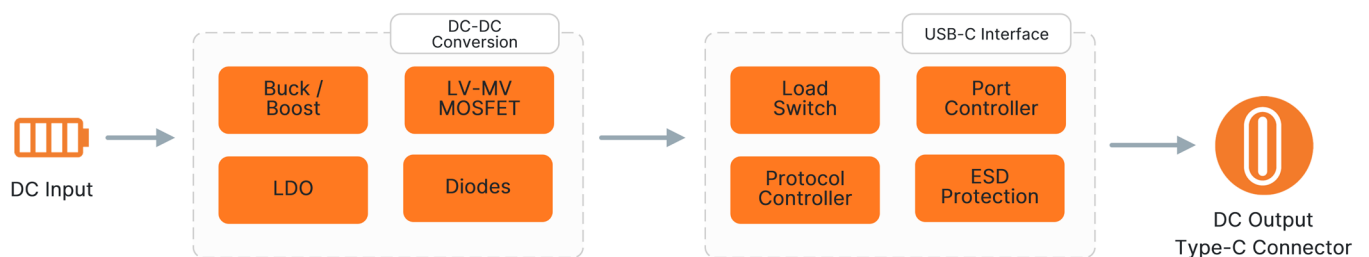
Block Diagram - USB-C Battery Charger

The block diagram below represents USB-C Battery Charger solution created by **onsemi**. The diagram illustrates the power management and power conversion technologies utilized in USB-C battery chargers. It features components such as the TP PFC controller, High-Frequency Quasi-Resonant Flyback / LLC controllers, gate drivers, synchronous rectification, as well as iGaN and MOSFET devices. These elements are categorized into primary and secondary stages to enhance system efficiency. Majority of the functional block devices can be sourced by the **onsemi** solutions as shown in the following device tables.

USB-C Battery Charger - AC Input



USB-C Battery Charger - DC Input (Auto)



Use our Interactive Block Diagrams Tool



Open IBD Tool

USB-C PD Charger Reference Designs

Get Latest
Version

onsemi USB-C PD Charger Reference Designs

Leveraging the robust technical expertise, **onsemi** offers a suite of highly efficient system reference designs and evaluation boards, as shown in Table 2.

Table 2: **onsemi's** series of USB-C PD system reference boards

Power Rating	Topologies	Support	Output Voltage	Efficiency (Max.)	Typical Application
65 W	HF QR Flyback + SR	PD3.0 & PPS protocol	3 V – 21 V (PPS)	> 93%	Smart phone, PAD, NB adapter
100 W	CrM Boost PFC+HF QR Flyback + SR	PD3.0 & PPS protocol	3 V – 21 V (PPS)	> 92%	Smart phone, PAD, NB adapter
240 W	TP CrM PFC + 2 Switch Flyback	PD3.1 EPR	up to 48 V	> 95%	Adapter for computer and smartphone, Industrial and lighting power supply
240 W	TP CrM PFC + LLC UHD	PD3.1 EPR	up to 48 V	> 96%	Adapter for computer and smartphone, Industrial and lighting power supply

240W TP CrM PFC + 2 Switch Flyback Reference Design

Leveraging the robust technical expertise, **onsemi** offers a suite of highly efficient system reference designs and evaluation boards, as shown in Table 2.

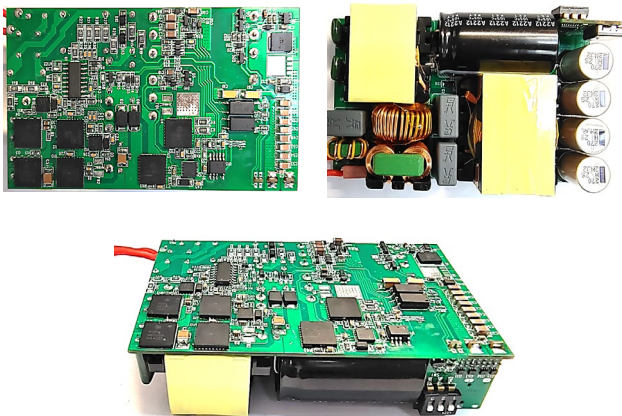


Figure 6: EVB of 240W TPFC + 2SW QR Flyback

Features

- AC input from 90V to 264V
- Totempole CrM PFC + 2SW Flyback Topology
- High Frequency operation with **iGaN**
- Simulated circuit to support PD3.1 multi-output
- Output voltage 5V, 9V, 12, 15V, 20V, 28V, 36V & 48V / 5A
- Ripple & Noise: <150 mV
- Efficiency: AVG 94.75% / 95.43% & Full load 95.12% / 96.17% @115VAC / 230VAC and 48V / 5A
- Output precise OVP, OCP, SCP, Open loop protection
- PCBA size: 89mm x 51mm x 21.5mm, 40W/in³

Find Reference Design

USB PD Controller

Get Latest
Version

USB PD Controller [FUSB1501](#)

Programmable USB Type-C and Power Delivery 3.1 Source Controller with PPS Support

Key Features:

- Fully Programmable and Upgradable Open-source Firmware providing API for Customer Specific Device Policy Manager Development
- Robust Collection of Peripherals including DACs, ADC, NTCs and NMOS Gate Driver
- Programmable Constant Voltage & Current Control with Cable Drop Compensation
- USB PD 3.1 with PPS Support and integrated VCONN support for E-Marked Cables
- Idle and Sleep Modes to Meet CoC and DoE Requirement
- Full Fault Protection - OVP, OUP, OCP and OTP
- Integrated UART Transceiver

Typical applications: AC-DC USB PD Compliant Adapters, Wall Chargers for Mobile Phones and Tablets and Computing Devices, Power Banks

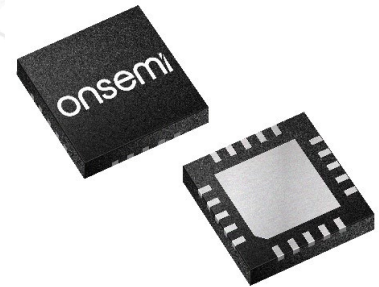


Figure 26: 20-pin QFN
4 x 4mm Package

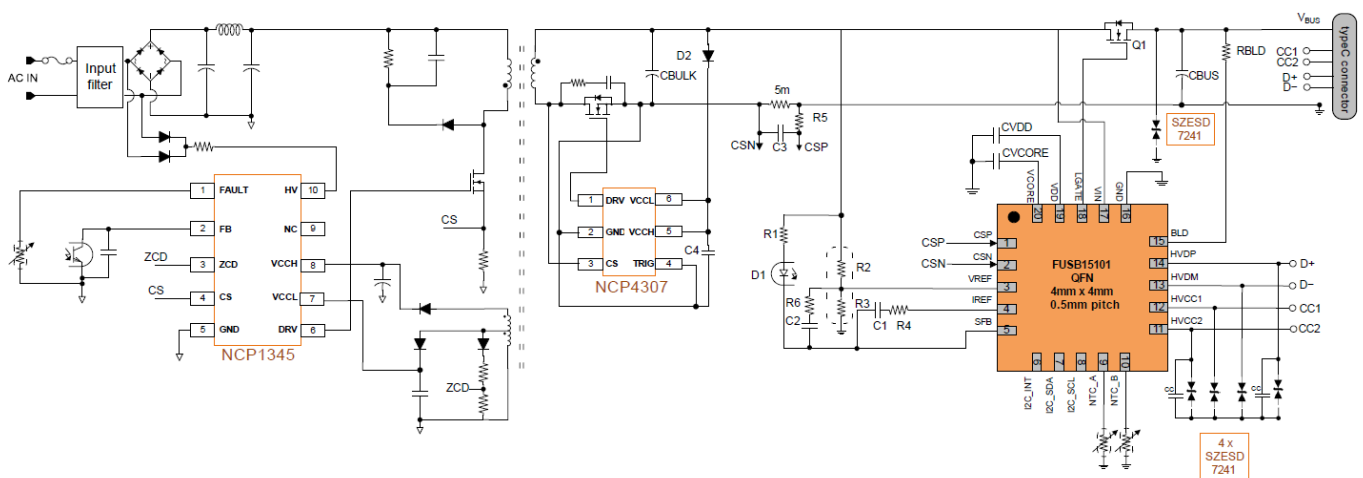


Figure 27: AC/DC Application Schematic

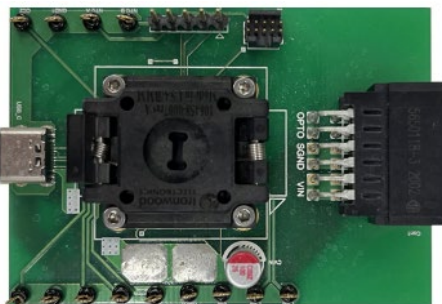


Figure 28: [FUSB1501](#) Socket

FUSB1501 Evaluation Board (EV) Guide [UM70086/D](#)

- An ease-of-use evaluation board with together with the firmware binary provided in the release package permits a customer to program the one-time programmable (OTP) non-volatile memory (NVM) of FUSB1501
- Software Development Kit (SDK) including USB PD protocol stacks, sample code, libraries and documentation

Learn more about **onsemi's** [USB Type-C PD controller families](#)

USB-C Battery Charger

Get Latest
Version

onsemi™

Intelligent Technology. Better Future.

Register now to unlock all System Solution Guides and get additional exclusive benefits!

-  Join the conversation on community forum.
-  Utilize Elite Power Simulator & other developer tools.
-  Watch exclusive webinars and seminars.

Open full System Solution Guide



onsemi, the onsemi logo, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using onsemi products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by onsemi. "Typical" parameters which may be provided in onsemi data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. onsemi does not convey any license under any of its intellectual property rights nor the rights of others. onsemi products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use onsemi products for any such unintended or unauthorized application, Buyer shall indemnify and hold onsemi and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that onsemi was negligent regarding the design or manufacture of the part. onsemi is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.