

USB-C™ Suite of Solutions for AC-DC and DC-DC

by Julie Tyler - 05-05-2020

Legacy USB Type-A and Micro B cables traditionally had assigned source and device form factors. **USB-C** (also known as **USB Type-C**) introduces flexibility so the cable ends can be used interchangeably and in any orientation. **USB-C with power delivery (PD)** allows systems to negotiate up to 100W of power, far exceeding the previous limitation of 7.5W. The data rates for the USB-C PD standard have also migrated to allow up to 40Gbps.



In order to achieve functionality between two or more **USB-C** systems, the systems must communicate and assign the device that will provide power and data and which device will receive the transferred power and data. This type of device communication role assignment is new to USB. As a result, the **USB-C** system must be thoughtfully designed for specific applications. ON Semiconductor offers a full suite of AC-DC and DC-DC solutions including reference designs, sample firmware and industry-leading GUI interfaces. ON Semiconductor's solutions empower customers to quickly and confidently integrate **USB-C** into their platforms.

AC-DC solutions

AC-DC solutions are used in end applications such as **AC-DC wall adapters**, **USB wall receptacles** and industrial power systems.

For intelligent AC-DC applications using the latest USB charging standards, ON Semiconductor has recently introduced a new fully integrated **USB-C PD** and PPS controller with a synchronous rectifier. The **FAN6390** integrates the policy manager and is **USB-C PD 3.0** and PPS compliant. It utilizes a very low 5mΩ sense resistor for a fully integrated power solution for up to 60W. High voltage protection on CC lines can also be added to the AC-DC solution as well. The **FAN6390** meets all the requirements for compliant **USB-C and USB PD designs**.

Complementing the **FAN6390** is our company's complete offering of primary side solutions for isolated AC-DC applications. The block diagram below exemplifies our best-in-class AC-DC solutions with their enhanced levels of intelligence to provide the best charging experience for users, even those who keep multiple devices running all throughout the day.

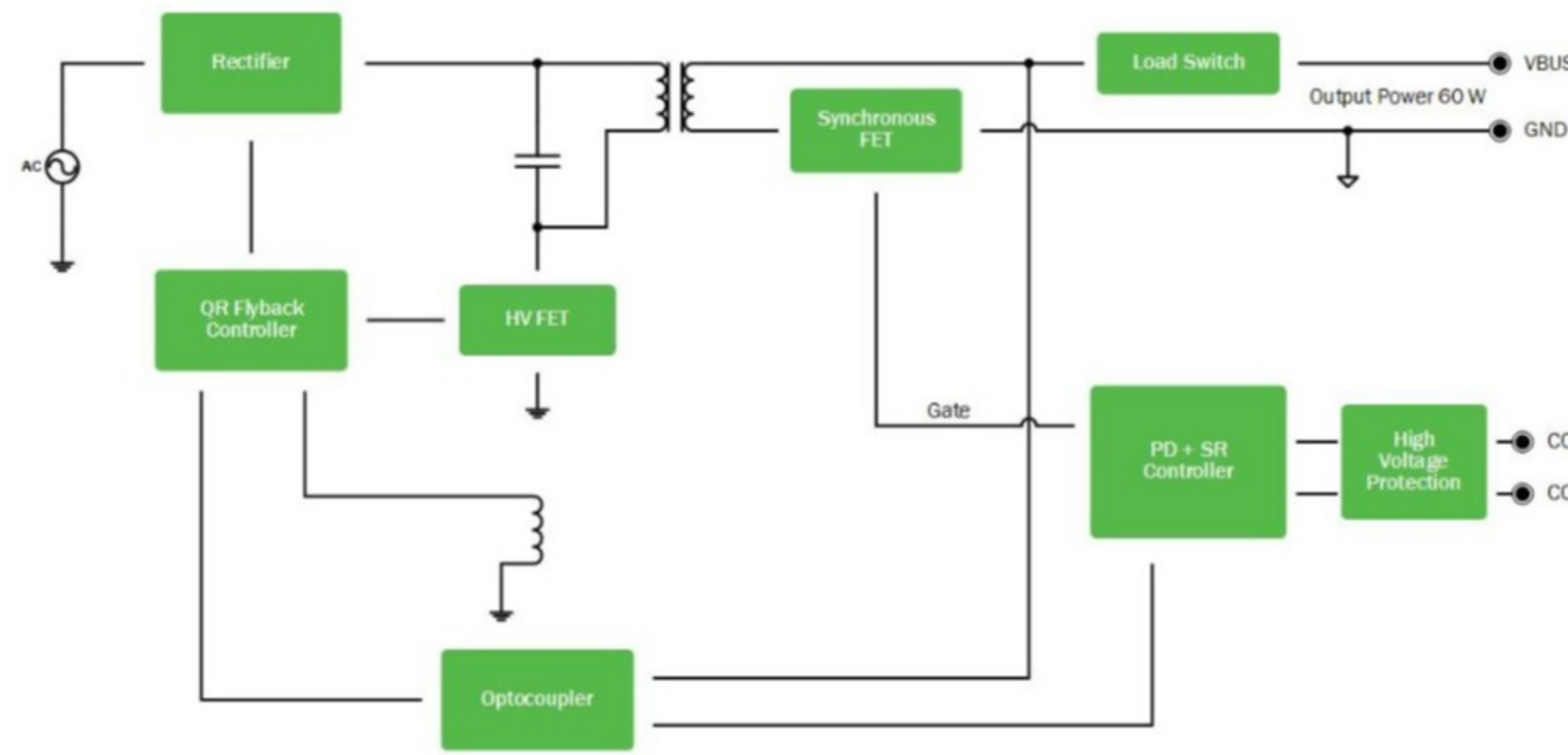


Figure 1: USB-C AC-DC Solutions Block Diagram

This block diagram solution supports up to 60 watts of output power supplied at VBUS of 20 V. The maximum output current of this design is 3 A and which can negotiate VBUS to either 5 V, 11 V or 15 V, keeping with the standard voltage offerings defined in the **USB-C PD** standard. When a **USB-C PD** contract is not needed for charging, the **FAN6390** configures the port to provide power as defined by the **USB-C standard**. From communicating with the primary side by opto-coupler to integrating all the necessary control to implement the USB-C PD policy manager, the **FAN6390** provides the AC-DC designer the tools to successfully utilize the latest USB-C charging standards.

For the AC-DC solutions, ON Semiconductor offers a high performing primary including the **MDB10S**, a 1A, 1000V low forward drop single-phase bridge rectifier. The star of the show, however, is the **NCP1342**, the high performing quasi-resonant flyback controller. It includes an integrated high voltage start-up and uses a proprietary Rapid Frequency Foldback technique to enhance light load efficiency for high switching frequencies. This means higher power density and smaller adapters due to smaller transformer and components.

Suggested Block	Device	Description
Rectifier	MDB10S	1A, 1000V, MicroDIP, Single-Phase Bridge Rectifier
HV FET	FCMT299N60	Power MOSFET, N-Channel, SuperFET® II, FAST, 600V, 4.5A, 900mΩ, IPAK
QR Flyback Controller	NCP1342	Offline Quasi-Resonant PWM Controller
Optocoupler	FOD819	Phototransistor Optocouplers, High Speed, 4-Pin DIP
Synchronous FET	FDMS7580	N-Channel Shielded Gate PowerTrench® MOSFET 100V, 124A, 4.2mΩ
Load Switch	FDMS7580	N-Channel Power Trench MOSFET 25V, 7.5 mΩ
Type-C PD Controller with SR	FAN6390MPX	USB PD 3.0 with Programmable Power Supply (PPS) with integrated Synchronous Rectifier
High Voltage Protection	FUSB252UMX	High Speed Digital (HSD) Port Protection Switch with Type-C CC

DC-DC solutions

DC-DC solutions are used in end applications such as **PC/Laptop**, **smartphones**, **docking stations**, **accessories**, **automotive**, **wearables**, consumer and industrial.

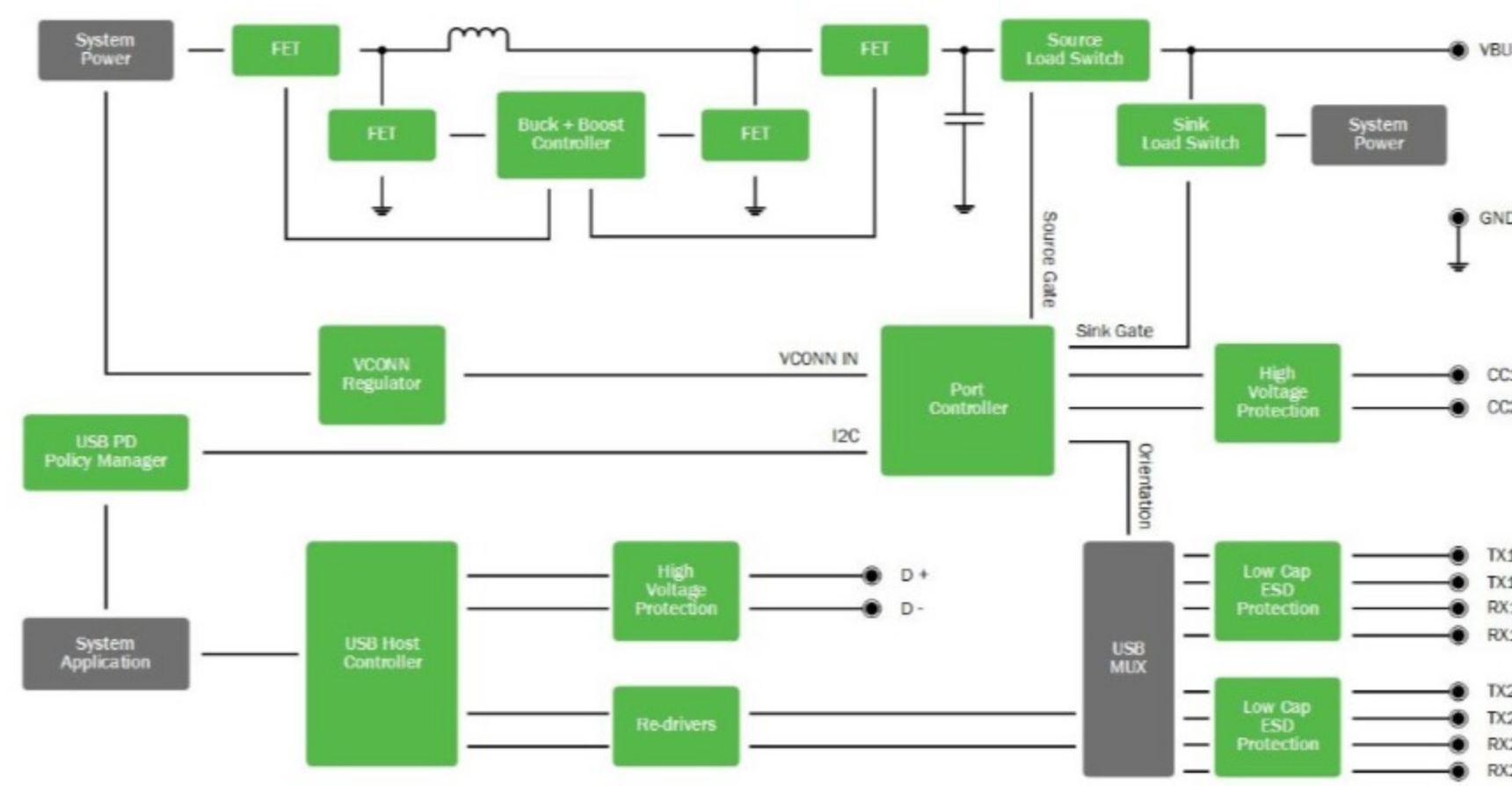


Figure 2: USB-C DC-DC Solutions Block Diagram

The DC-DC solutions include the **NCP81599** with a buck/boost and four integrated 40V FET drivers. It's QC 3.0 compliant and highly flexible through I2C programming. Power passes through isolation switches specifically designed for current limiting and overvoltage protection. The **FUSB307B** USB-C controller itself is fully compliant to PD 3.0 and TCPC and is ideal for multiple port systems. Data rates for **USB-C** can be as high as 10Gbps which means signal integrity can degrade due to PCB traces and transmission cables. ON Semiconductor has a portfolio of redrivers such as the **NB7NPQ1004M** that compensate for these losses by engaging varying levels of equalization at the input receiver and flat gain amplification on the output transmitter. The signals can also be multiplexed through a SS switch which maintains signal integrity.

Suggested Block	Device Number	Description
Buck-Boost Controller	NCP81239	4-Switch Buck Boost Controller, USB Power Delivery and Type-C Applications
Buck-Boost FETs	NTMF55C404NT1G	Single N-Channel Power MOSFET 40V, 107A, 3.1mΩ
Source / Sink Load Switch	FPF2895C	Current Limit Switch with OVP and TRCB, 28 V / 5 A
Type-C PD Controller	FUSB307B	USB-C PD TCPC Port Controller
High Voltage Protection	FUSB252UMX	High Speed Digital (HSD) Port Protection Switch with Type-C CC
Redrivers	NB7NPQ1004M	3.3 V USB 3.1 Gen-2 10 Gbps Quad Channel / Dual Port Linear Redriver
USB 3.1 Mux	FUSB340	USB 3.1 SuperSpeed Data Switch, 10 Gbps
Low Cap ESD Protection	ESD7104MUTAG	ESD Protection, Low Capacitance, High Speed Data

ON Semiconductor is making strides in the **USB-C PD** market segment by enabling and empower AC-DC and DC-DC designers the necessary tools to easily and successfully integrate the latest USB standards into their designs. In addition to the block diagram, ON Semiconductor offers a significant portfolio of application-specific reference designs. The reference designs include customer-friendly GUIs and sample reference code is available in some cases. Continue learning about our **USB-C solutions** and how they can fulfill your design and solution needs in various applications.

Check out the data sheets referenced within this blog below:

- [FAN6390](#)
- [NCP1342](#)
- [MDB8S](#)
- [NCP81599](#)
- [NB7NPQ1004M](#)