



System Solution Guide - Preview

Switched-Mode Power Supply (SMPS)



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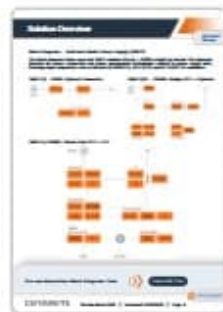
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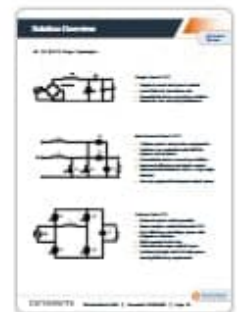
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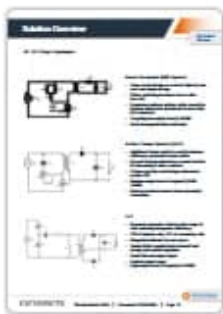
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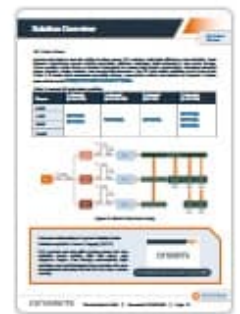
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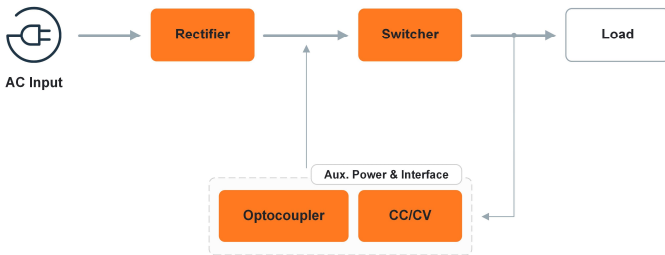
Block Diagram - SMPS

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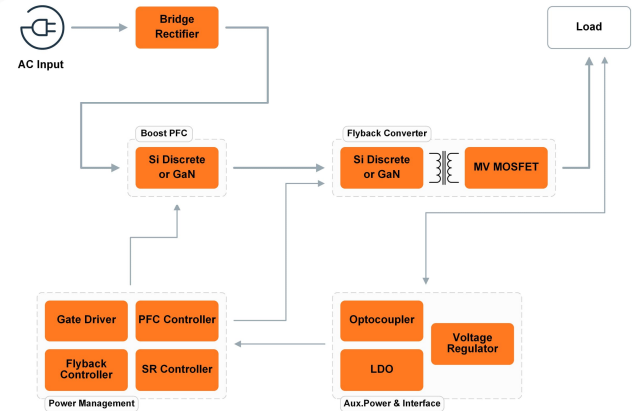
Block Diagrams - Switched-Mode Power Supply (SMPS)

The block diagrams below represent SMPS solutions (5w to > 200W) created by **onsemi**. The diagrams illustrate the power conversion and power management technologies utilized in power supply units, featuring major components such as discrete SiC MOSFETs, SiC CJFETs and AC-DC/DC-DC controllers.

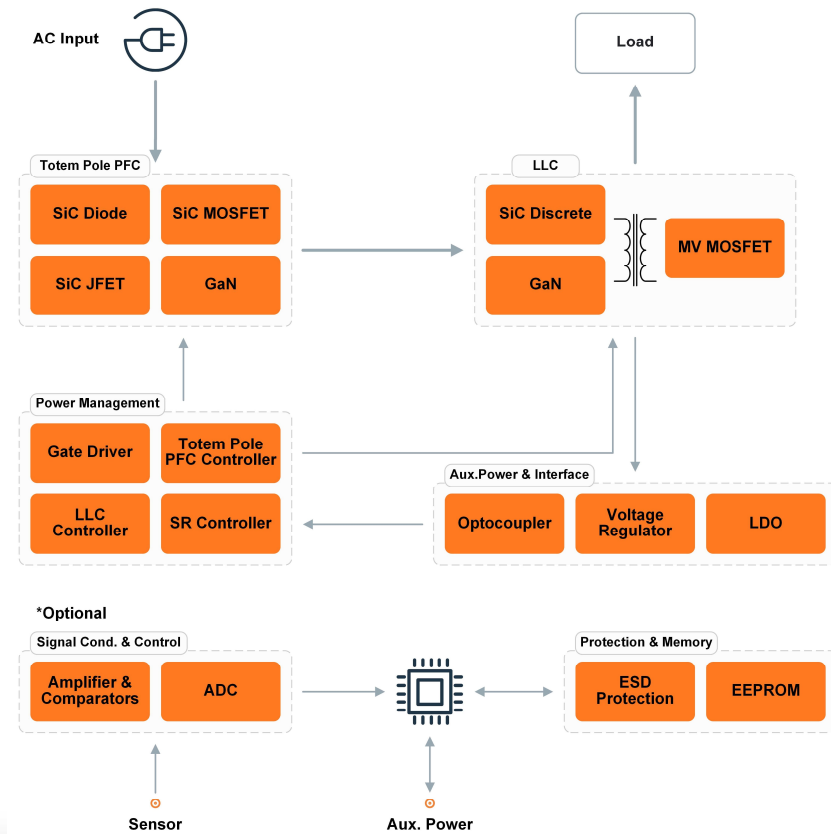
SMPS (5 - 65W): Flyback Converter



SMPS (65 - 200W): Bridge PFC + Flyback



SMPS (>200W): Totem Pole PFC + LLC



Use our Interactive Block Diagrams Tool



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SMPS Matrix

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Easy to Use SMPS Matrix

onsemi's SMPS Matrix (Table 2) offers a comprehensive range of power management options tailored for various applications. These solutions cover power ranges from 5W to over 3kW. For instance, the matrix includes controllers, gate drivers, and switches designed for applications such as Power Factor Correction (PFC), Active Clamp Flyback (ACF), Quasi Resonant Flyback (QR), and Synchronous Rectifier Controller (SRC) configurations. These solutions are optimized to provide reliable and efficient power conversion, catering to diverse needs from low-power USB-C PD designs to high-power industrial and telecom applications.

By leveraging advanced technologies like SiC and GaN, **onsemi** ensures the SMPS Matrix solutions deliver superior performance and energy efficiency for a wide range of power management requirements.

Table 2: **onsemi** "Easy to Use" SMPS Matrix

Power Range (W)	Power Density Rating	Rectifier	Primary Side										Secondary Side		USB-C/PD
			PFC			ACF			QR Flyback		LLC		Controller	SR Switch	
			Controller	Power Switch	Slow / Fast Leg Gate Drive	Controller	HV (Q2) Gate Drive	Power Switch	Controller	Power Switch	Controller	HS/LS Switch / Gate Drive			
1kW to >3kW (24-48V)	Ultra High	w/o	NCP1681 (CCM)	SiC / GaN	NCP51530 / NCP51561	NA					NCP13994		NCP4318	NA	
	High	DFB25100 / DFB2580	FAN9672 / FAN9673 (CCM)	HV MOSFET	NA					NCP4390	SiC / GaN / NCP51561	NA			
350W to 1kW (12V-24V)	Ultra High	w/o	NCP1681	SiC / GaN	NCP51530 / NCP51561	NA							LV-MV MOSFET		
	High	DFB20100 / DFB2080	NCP1618 (MM)	HV MOSFET	NA						HV MOSFET				
200W to 350W (12V-24V)	Ultra High	w/o	NCP1680 (TP CrM)	SiC / GaN	NCP51530 / NCP51561	NA					NCP13994				NCP4318
	Low Profile	DFB20100 / DFB2080	NCP1632 (CrM)	SiC / GaN / NCD 57000	NA						SiC / GaN / NCP51561				
	High		NCP1616 (CrM)	HV MOSFET	NA						HV MOSFET				
70W to 200W (12V-24V)	Ultra High	GBU8M / GBU8K	NCP1623	SiC / GaN / NCD 57000	NA	NCP1568	NCP51561	SiC / GaN	NA			NCP4307		FUSB1520 1	
	High	GBU6M / GBU6K		HV MOSFET	NA			NCP1343	HV MOSFET	NA					
65W (3.3V-21V)	High	GBU4M / GBU4K	NA			NCP1345	HV MOSFET	NA		NA		NCP4306			
25W to 50W	High		Switchers: NCP11184 / NCP11185 / NCP11187												
5W to 25W	High	DF10S / DF08S	Switchers: NCP1072 / NCP1075 / NCP1076 / NCP1077												

NA: Not Applicable



Figure 3: Applications per Power Level

Power Supply Reference Designs

onsemi offers a versatile range of SMPS solutions that cater to various power requirements, spanning from 65W to over 3kW. Their product lineup includes controllers, gate drivers, MOSFETs, and advanced WBG materials like SiC and GaN. These solutions are designed to provide high efficiency, reliability, and performance across a wide range of applications, including USB-C PD, industrial power supplies, and cloud server power supplies.

3kW EliteSiC Totem Pole PFC + LLC PSU

- High power density topology - Totem Pole PFC + LLC
- $V_{in} = 85V-264V$, $V_{out} = 54V$, $I_{out} = 55.5A$
- PFC Efficiency > 98% @100% load
- System Peak Efficiency > 94% @115VAC; > 96% @230VAC
- PCBA size: 280mm x 110mm x 38mm
- Featuring products: Multi-mode TP PFC [NCP1681](#), LLC with SR Controller [NCP4390](#), Isolated HB Gate Driver [NCP51561](#), 650V SiC MOSFET [NTHL045N065SC1](#)
- Application: Industrial PSU

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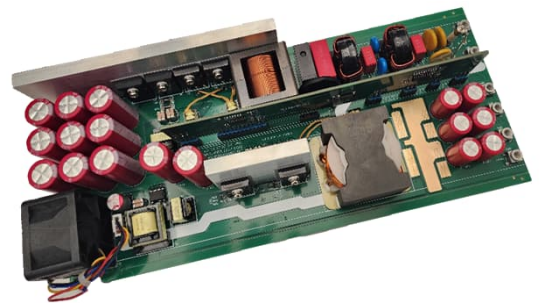


Figure 4: 3kW Totem Pole PFC + LLC PSU Evaluation Board

1 kW Universal Input 48V Output Power Supply

- High efficiency Totem Pole CCM PFC + HF LLC
- $V_{in} = 90-265VAC$, $V_{out} = 48V$, $I_{out} = 21A$
- Full load efficiency: 92.5% & 95.4% @110 & 230VAC
- PCBA size: 328mm x 93mm x 50mm
- Power Density: 10.74W/in³
- Featuring products: TP PFC [NCP1681](#), LLC [NCP13994](#), iGaN [NCP58921](#), [NCP58920](#) & SR Controller [NCP4306](#)
- Application: Computing Power Supply, Industrial PSU

Find Reference Design

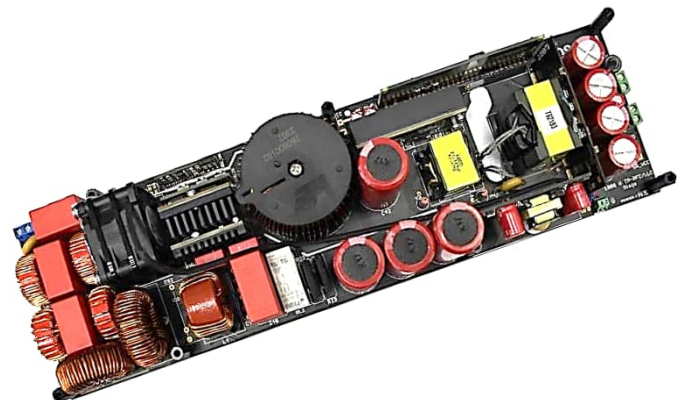


Figure 5: 1 kW 48V Output Power Supply Evaluation Board

Explore more power supply reference designs and evaluation boards from System Solution Guide – USB-C Battery Charger as below link.

Find more information in System Solution Guide:

USB-C Battery Charger

USB-C battery chargers have become the universal standard for quickly and effectively charging a wide range of portable devices, thanks to their high-power delivery and efficiency. The adoption of wide-bandgap semiconductors in these chargers further enhances efficiency, reduces energy losses, and contributes to the reduction in device size.

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Frequently Asked Questions (FAQ)

What is a switched-mode power supply (SMPS), and where is it used?

1 A switched-mode power supply (SMPS) converts AC grid power into regulated DC for end loads, typically using two conversion stages to maximize efficiency. SMPS spans from ~65 W laptop adapters to multi-kilowatt server power supplies, and it's widely used across consumer, industrial, telecom, and data center applications where efficiency, size, and reliability matter.

Why do modern SMPS designs often use a PFC stage plus an isolated DC-DC stage?

2 Many SMPS architectures use an AC-DC front end with power factor correction (PFC) to meet emissions/efficiency expectations, then an isolated DC-DC stage to generate the required output rails. The control IC monitors feedback and drives the switching devices to maintain stable DC output even when input conditions vary.

What makes onsemi's 3 kW Totem Pole PFC + LLC PSU solution relevant for high-power designs?

3 onsemi highlights a 3 kW **EliteSiC** Totem Pole PFC + LLC PSU solution as a high-density, efficient, cost-effective architecture with advanced control features and robust performance across a wide range of applications. This is a common high-power path where Totem Pole PFC reduces front-end losses and LLC supports efficient isolated conversion.

How do CCM, CrM, DCM, and onsemi FCCrM impact SMPS efficiency and EMI tradeoffs?

4 Control mode strongly affects topology and system behavior: CCM is popular at higher power with minimized peak/RMS currents; CrM is common at low power with variable frequency; DCM often appears at light load to help power factor and limit EMI near line zero crossing. onsemi's FCCrM clamps CrM frequency spread by forcing DCM under light-load/zero-crossing conditions.

Which global efficiency and regulatory standards influence offline SMPS design requirements?

5 Offline SMPS designs often consider safety and EMC/efficiency requirements. The guide references IEC 62368-1 (safety/insulation definitions) and harmonic current limits under IEC 61000-3-2 (≤ 16 A) and IEC 61000-3-12 (> 16 A). For efficiency, it notes U.S. DoE Level VI, EU CoC for EPS, and the 80 PLUS® program up to Titanium targets.




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