Power Supply Solutions

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Pushing innovation to create intelligent power and sensing technologies that solve the most challenging customer problems.

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What is a Power Supply?

Switch Mode Power Supplies (SMPS) can be found in almost every electronic device. They are one of the most widely used power supplies because of their compact size and high efficiency. A SMPS integrates controllable switches, a control IC and passive components, providing a sustainable and reliable output to loads.

DC-DC and AC-DC power conversion are the two most common power supply types. Most loads require DC input, such as chips inside cell phones, laptops and high-power servers in datacenters.

A DC-DC converter is the core component of a modern SMPS, converting DC input into the required DC output. AC-DC converters, so-called offline converters, rectify AC input from the grid into DC to be used as the input for the secondary DC-DC conversion stage. It is very important to create stable output DC power from an input which might be unstable or variable. Therefore, a control IC is necessary to monitor the circuits, provide feedback, and control the switches simultaneously.

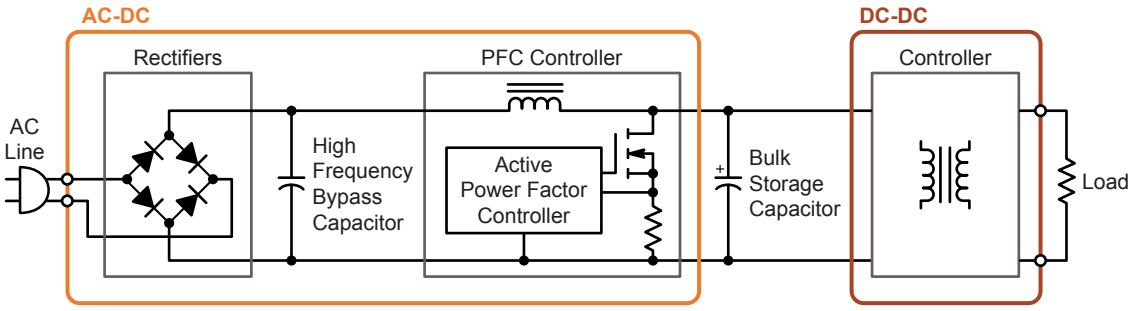
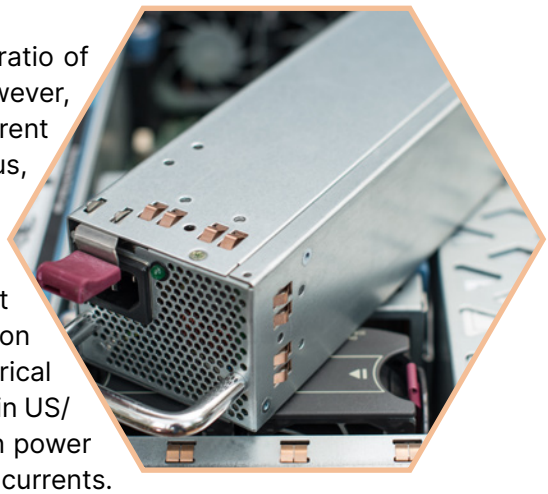


Figure 1. Typical Power Supply

What Is the Trend?



High efficiency is always the goal of a modern SMPS. Efficiency is the ratio of power drawn from the grid to the useful power supplied to the load. However, if the input line current and voltage are out-of-phase or have different waveforms, the apparent power drawn can be significantly higher, thus, dramatically reducing efficiency.

The method to solve the out-of-phase issue is called PFC (Power Factor Correction). A PFC stage can be inserted between the AC input and the secondary DC-DC converter to reduce harmonic current distortion and improve power factor to provide a stable DC output. Today, electrical equipment must comply with regulatory requirements like IEC61000-3-2 in US/Canada, EN61000-3-2 in EU and GB/T 14549-93 in China to ensure high power factor and low total harmonic distortion at various input voltages and load currents.

In addition, new efficiency standards stipulate efficiency levels across a wider range of operating power. For example, the 80 PLUS® program promotes 80% efficiency or greater, between 20% and 100% loading and a power factor of 0.9 or higher at 100% loading. The highest level in this program (known as the 80+ Titanium standard) specifies a minimum efficiency of 92% at 20% loading and 94 % efficiency at 100 % loading.

Higher power density is critical to meeting growing energy demand everywhere and the market's continued need for smaller and more efficient power supply. Furthermore, higher power density means better thermal management, EMI immunity, and smaller passive size which benefits from the higher system operating frequency.

onsemi's Power Supply Solutions

As an enduring topic, there are always various challenges when designing a power supply as new requirements and technologies arise. For example, Power and passive components

- Topologies
- Cost controlling
- Controller selection
- System monitoring and protection
- EMI and noise
- PCB layout
- Thermal management

Therefore, it is important to make choices according to the actual demands.

As a leading power supply solution provider, onsemi offers a comprehensive portfolio of power supply components including power switches, offline controllers, gate drivers, regulators, and many more. We also offer evaluation boards and system level simulation tools to reduce development time.

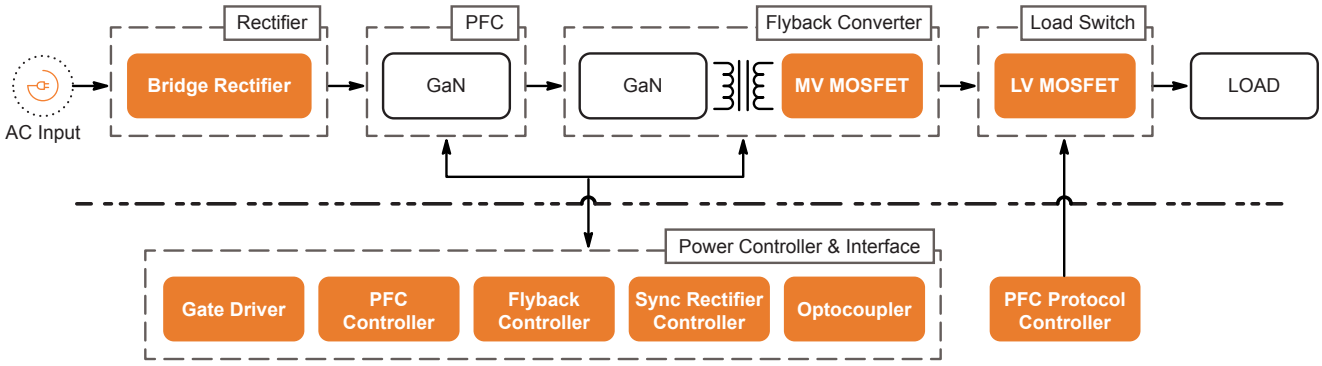


Figure 2. Typical Block Diagram
Low/Med-Power Power Supply Unit/Battery Charger with PD3.1

Block	Product	Device Number	Description
Rectifier	Bridge Recitifer	GBU6J	Bridge Rectifiers 600V
Flyback Converter	MV MOSFET	NTMFS3D2N10MD	PowerTrench® MOSFET 100V, 3.2mΩ
		NTMTS1D5N08H	PowerTrench® MOSFET 80V, 1.5mΩ
Load Switch	LV MOSFET	NTMFS0D5N04XL	Power MOSFET 40V, 0.49mΩ
Contoller & Interface	PFC Controller	NCP1623	CrM PFC Controller
	Flyback Controller	NCP1343	QR Flyback Controller
		NCP1568	ACF Controller
	Gate Driver	NCP51530	700 V- 3.5/3.0 A Half Bridge Gate Driver
	Optocoupler	FODM1009	Single Channel Phototransistor Optocoupler
	Sync. Rectifier Controller	NCP4306	Secondary Sync. Rectification Driver
PD Protocol Controller		FUSB15101	Programmable PD 3.1 Controller

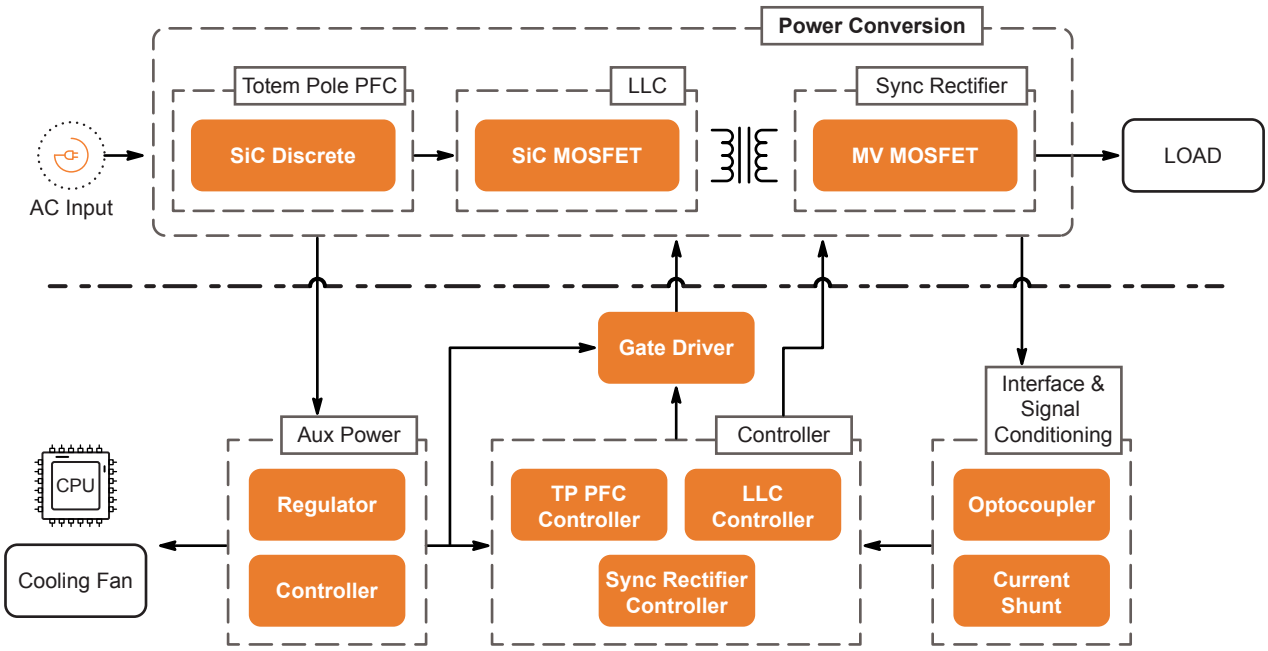
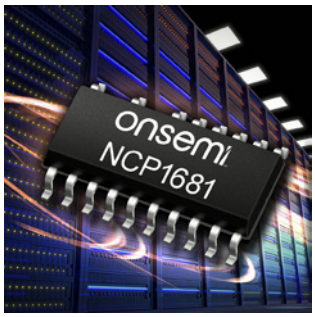


Figure 3. Typical Block Diagram
High-power/High power density Power Supply Unit

Block	Product	Device Number	Description
Totem Pole PFC	SiC Discrete	NTBG015N065SC1	SiC MOSFET - EliteSiC, 12mΩ, 650 V, D2PAK
		NTBL045N065SC1	SiC MOSFET - EliteSiC, 33mΩ, 650V, TOLL
		FFSB0665B	SiC Diode – EliteSiC, 6A, 650V, D2PAK
LLC	SiC Discrete	NTBG015N065SC1	SiC MOSFET - EliteSiC, 12mΩ, 650V, D2PAK
		NTH4L015N065SC1	SiC MOSFET - EliteSiC, 12mΩ, 650V, TO-247-4L
Sync. Rectifier	MV MOSFET	NTMFS3D2N10MD	PowerTrench® MOSFET 100V, 3.2mΩ
		NTMFS7D5N15MC	PowerTrench® MOSFET 150V, 7.9mΩ
Aux Power	Controller	NCP1568	ACF Controller
		NCP1343	QR Flyback Controller
	Regulator	NCP11184	Enhanced standby mode 2.25Ω, 800 V Switcher
Gate Driver	Gate Driver	NCP51561	Isolated Dual Channel 4.5/9 A Gate Driver
Controller	Totem Pole PFC Controller	NCP1681	Multi-Mode (CrM-CCM) Totem Pole PFC Controller
		NCP1680	CrM Totem Pole PFC Controller
	LLC Controller	NCP4390	LLC Controller with Sync. Rectifier Control
		NCP13994	Current Mode LLC Controller, Active X2
		NCP13992	Current Mode LLC Controller
	Sync. Rectification Controller	NCP4318	Dual Ch. Sync. Rectification Controller
Interface & Signal Conditioning	Optocoupler	FODM1009	Single Channel Phototransistor Optocoupler
	Current Shunt	NCS213	Current Sense Amplifier

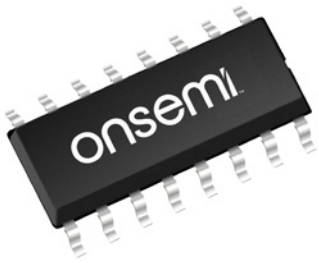
Featured Products

MM Totem Pole PFC Controller
NCP1681



Features

- Fixed frequency CCM w/ Constant on-time CrM and valley switching frequency foldback
- AC line monitoring & phase detection
- Novel current sensing scheme
- UVLO, thermal shutdown, Cycle by cycle current limit
- Target application - Ultra-high power density PSU



LLC Controller with Sync. Rectification Controller
NCP4390

Features

- Secondary Side PFM Controller for LLC Resonant Converter with Synchronous Rectifier Control
- Wide operating frequency (39 kHz ~ 690 kHz)
- NON ZVS prevention (NZP) by compensation cutback (frequency shift)
- Programmable deadtime

EliteSiC SiC MOSFET, 650 V
NTH4L015N065SC1

Features

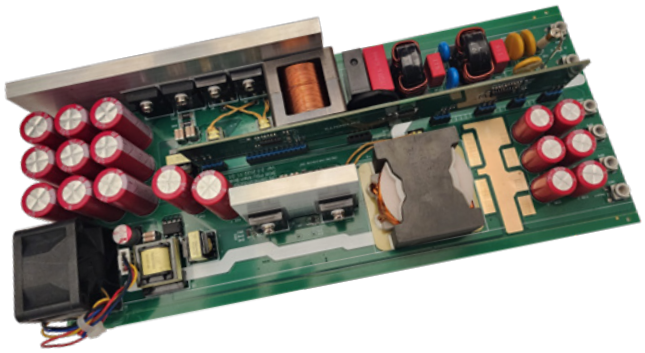
- Typical V_{BR} = 650 V, $R_{DS(ON)}$ = 15 mohm
- Kelvin Source
- High Speed Switching and Low cap

Evaluation Board

3 kW High Density PSU
3KW-TPLLC-GEVB'

Features

- High power density topology – Totem Pole PFC + LLC
- Silicon carbide based
- V_{in} = 80-230 V
- V_{out} = 48 V, I_{out} = 62.5 A
- Power Factor > 0.98 @ 20%-100% load
- System Efficiency > 98.4% @ 100% load
- Dimension = 280 × 110 × 38 mm
- Featuring products
  - MM Totem Pole PFC Controller – NCP1681
  - LLC Controller with SR Controller – NCP4390
  - Isolated Half Bridge Gate Driver – NCP51561
  - 650 V SiC MOSFET – NTHL045N65SC1
- Application: Industrial PSU



System-Level Simulation Tools

The **onsemi** online-based Elite Power Simulator provides meaningful insights for complex power electronic applications through system-level simulations at an early stage of the development cycle. The Elite Power Simulator delivers an accurate representation of how designed circuits will work using our EliteSiC family of products, including manufacturing corner cases of the EliteSiC technology.

Features

- Industry-first PLECS model valid for hard and soft switching simulation
- Covering DC-DC, AC-DC, DC-AC applications, including 32 circuit topologies in industrial and automotive
- Loss and thermal data plotting
- Flexible design and fast simulation result
- Product recommendation feature that is based on application and topology

Figure 4. Elite Power Simulator: Simulation Results and Waveforms

The Self-Service PLECS Model Generator grants electronics engineers the power and freedom to create custom high fidelity system level PLECS models. Engineers can use a model directly in their own simulation platform or upload it to the **onsemi** Elite Power Simulator to simulate.

Features

- Industry-first PLECS model valid for hard and soft switching simulation
- Custom application parasitics tailored to the user-specified application circuit parasitics which significantly influence conduction and switching energy losses
- High-density broad table tailored to user-specified electrical bias and temperature conditions for conduction and switching energy loss data
- Corner models valid at typical and corner conditions for the product, enabling users to track application performances in worst, nominal, and best-case fabrication conditions of the conduction and switching energy losses

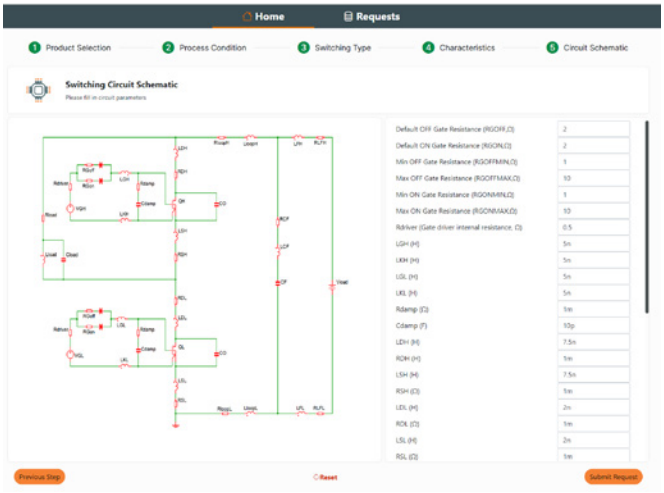


Figure 5. Self-Service PLECS Model Generator

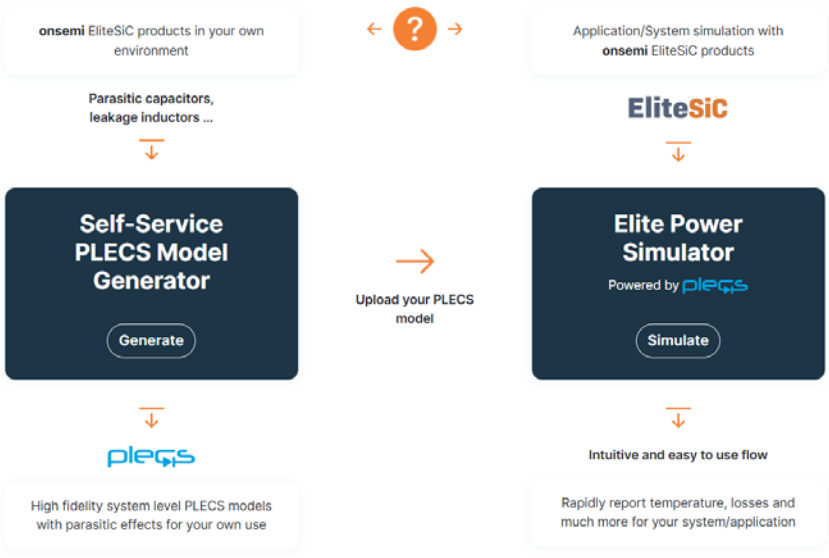


Figure 6. How to Choose Elite Power Simulator and Self-Service PLECS Model Generator

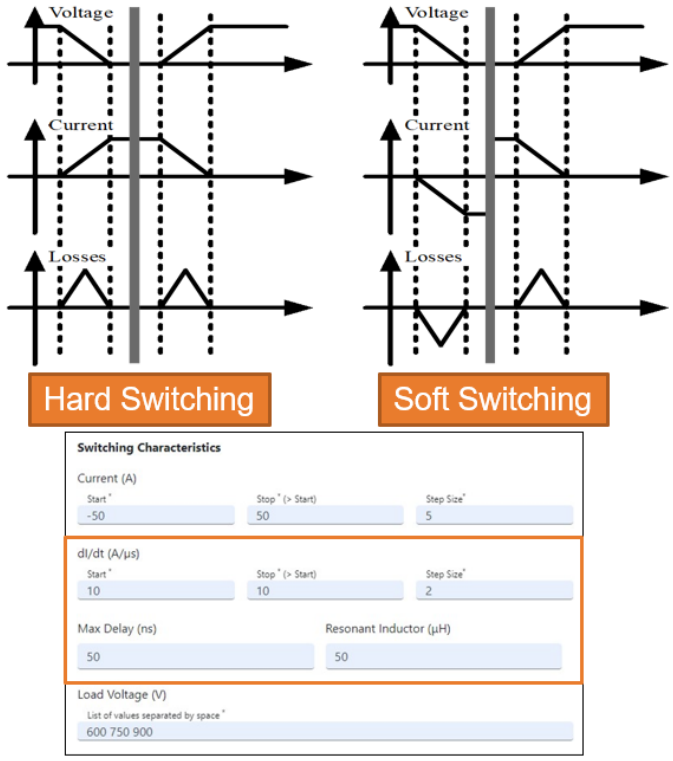


Figure 7. Self-Service PLECS Model Generator – Hard and Soft Switching Selection

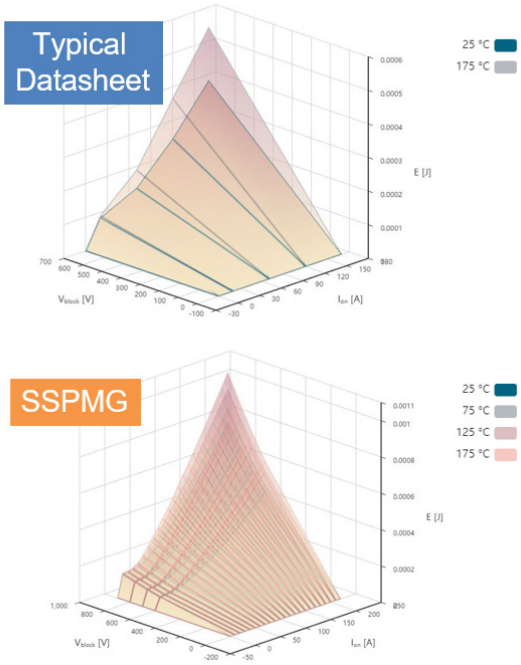


Figure 8. Self-Service PLECS Model Generator - Dense Loss Tables

Learn more about "Novel Industry-First Self-Service PLECS Model Generator and Elite Power Simulator Accurate For Soft and Hard-Switching".

ADDITIONAL INFORMATION

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