USB-C chargers & adapters

The semiconductor offering for high-performing, highly reliable and cost effective charging solutions

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Introduction

Over the last few years, the number of rechargeable battery-powered portable devices has increased substantially. The lack of unification and standardization in the charger and adapter equipment domain led to a situation that each device required its own bulky charger and cable, inconvenient for end-users.

To solve this, the USB-C power delivery (USB-PD) technology, standard for fast-charging and data transfer, gained significant importance. With the primary ambition of simplifying the end-user experience, USB-C PD chargers promise a compact-sized charging solution with higher power, making charging faster and more efficient. However, this convenience comes at the cost of higher engineering efforts.

From the technology point-of-view, the unification headway poses many new challenges to the engineers while laying the foundations of a highly competitive environment.

The latest technology and market trends in chargers and adapters are pushing the envelope of form-factor, charging power, battery capacity, and charging time. These needs are translated into more stringent performance requirements, i.e. a significant increase in power density and efficiency. Engineering teams must fulfill these requirements and at the same time, provide a comprehensive, customer-friendly, and high-quality solution at competitive cost. Ideally, all of these ahead of the competition to harvest the market by gaining more significant market share through a shorter time-to-market.

This selection guide will help designers to find the right-fit system solution that enables high-density USB-C charging designs at competitive cost.

Why Infineon

High-efficiency designs

- **ZVS control**
  Infineon's XDP™ controllers with zero voltage switching control and the PAG1 with secondary-side control, enable high-frequency operation with less switching losses and thereby reducing the size of passive components
- **High-efficiency switches**
  Power switches with low $R_{DS(on)}$ and parasitic parameters help to improve the system efficiency
- **High-performance packaging**
  The Kelvin-source engaged ThinPAK and PQFN packages can save power losses, reduce the PCB space, and improve thermal dissipation capabilities

Competitive cost

- **Total solutions**
  Infineon provides a comprehensive semiconductor offering from silicon to wide bandgap including high- and low-voltage power switches, digital controllers, and USB-PD protocol solutions
- **Complexity reduction**
  High-efficiency portfolios can save production efforts and overall cost
- **Ready-to-use reference designs**
  Reference designs help reducing design efforts and cost, shortening time to market to earn more profits

Differentiation

- **Programmable**
  Infineon's PWM controllers offer the flexibility to optimize the performance parameters by fine-tuning the firmware
- **Firmware upgradeability**
  Infineon's controllers, XDP™ and PAG, offer the flexibility to fix an existing issue or upgrade the firmware in the event of a PD spec update
- **Configurable**
  The PAG1 products offer the flexibility to configure the parameters including PDOs, fault protection thresholds, fault recovery mechanisms, and the operating frequency of the power adapter

Secured supply chain

- **Big capacity**
  Biggest power semiconductor capacity with 12' wafer production to secure upsurge demand
- **Flexibility**
  Dedicated supply chain program to enable flexibility to support the demand of the customers

One-stop-shop - multiple solutions

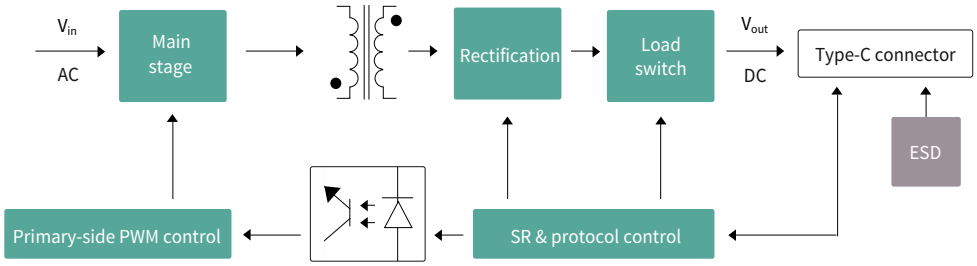
Application block diagram

Primary side

HV switch	Product offering
› **CoolMOS™**	› 800 V CoolMOS™ P7 › 700 V CoolMOS™ P7, CE › 600 V CoolMOS™ PFD7
› **CoolGaN™**	› CoolGaN™ IPS 600 V › CoolGaN™ 600 V e-mode HEMT*

Secondary side

LV/MV switch	Product offering
› **SR FET**	› OptiMOS™ PD 60 V, 80 V, 100 V, 120 V, 150 V › CoolGaN™ 100 V/200 V e-mode HEMT*
› **V_{bus} safety switch**	› OptiMOS™ PD 25 V, 30 V



Solution	Pulse width modulation	Synchronous rectification	Power delivery
› **65 W full GaN solution single-switch topology***	› EZ-PD™ PAG1P › CoolGaN™ 600 V e-mode HEMT*	EZ-PD™ PAG1S + CoolGaN™ 100 V / 200 V e-mode HEMT*	
› **Ultrahigh density ≤65 W ZVS half-bridge topology**	› XDP™ XDPS2201 (hybrid flyback)	3rd party	› EZ-PD™ CCG3PA
› **High density 45 W – 65 W ZVS flyback topology**	› XDP™ XDPS21071/XDPS21081 (FFR/FQR)	3rd party	› EZ-PD™ CCG3PA
› **18 W – 65 W QR flyback topology**	› EZ-PD™ PAG1P	› EZ-PD™ PAG1S	

*coming soon

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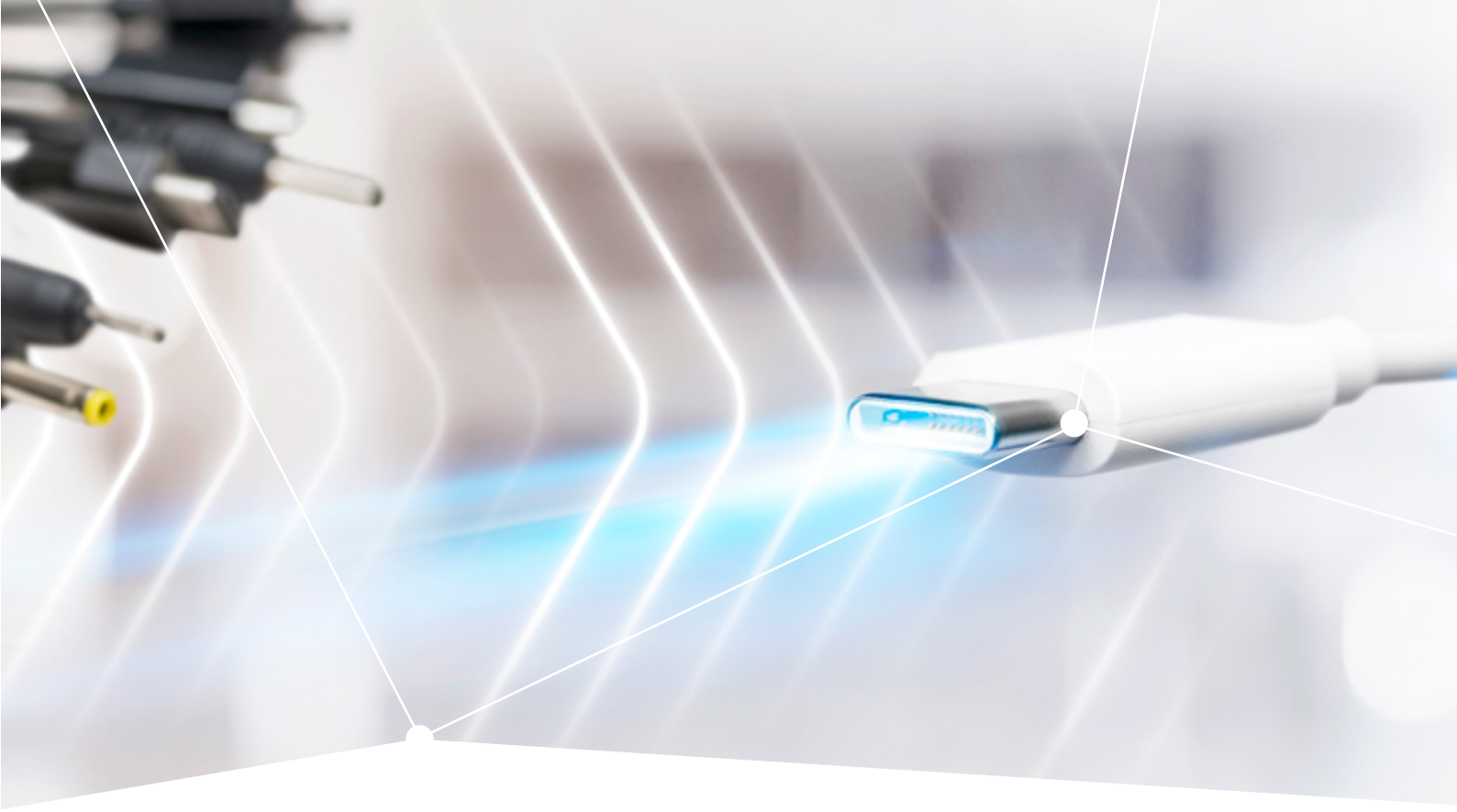
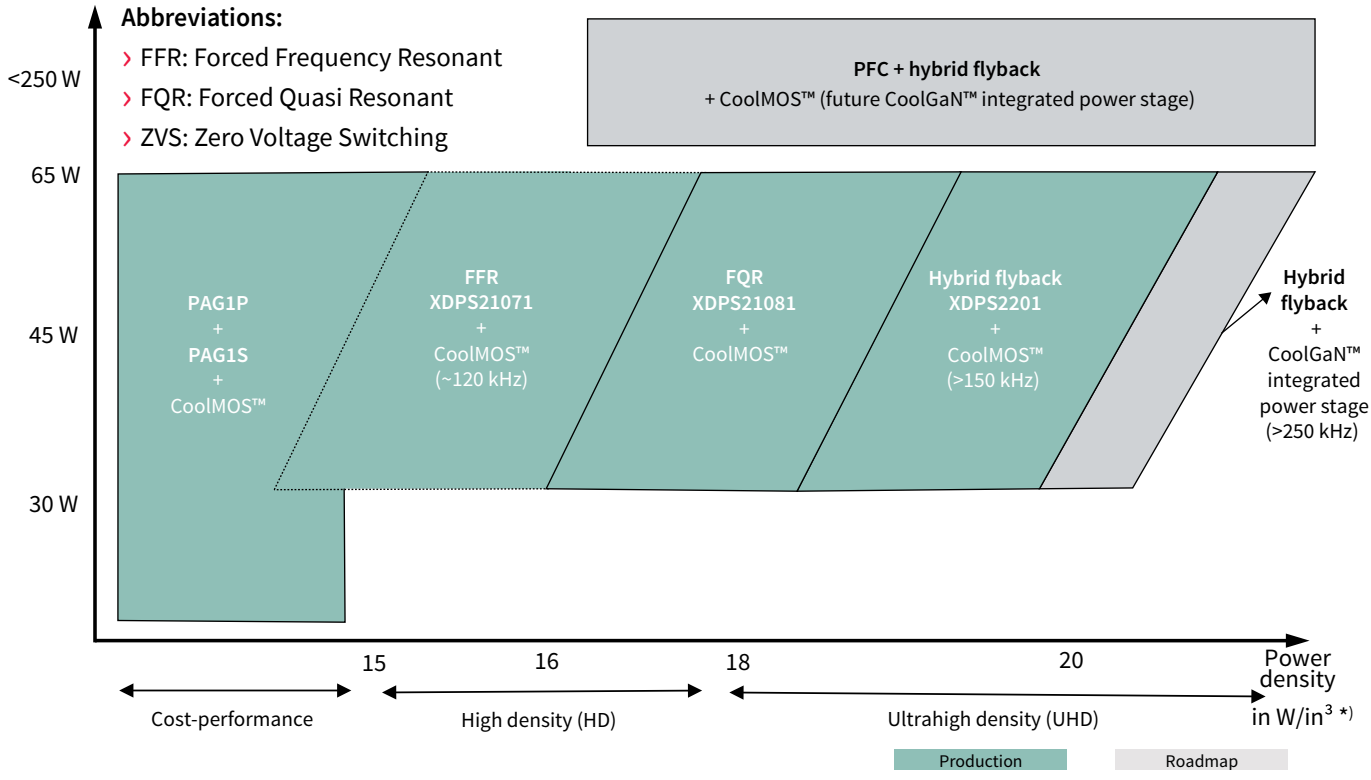


Perfect-fit solutions for prototyping

Shorten your time to market and reduce the development costs. Infineon's offer of reference designs provides the right environment for fast and easy prototyping. With available simulations, technical documentation, and global system support, Infineon is your reliable partner in every step of your USB-C charger design project.



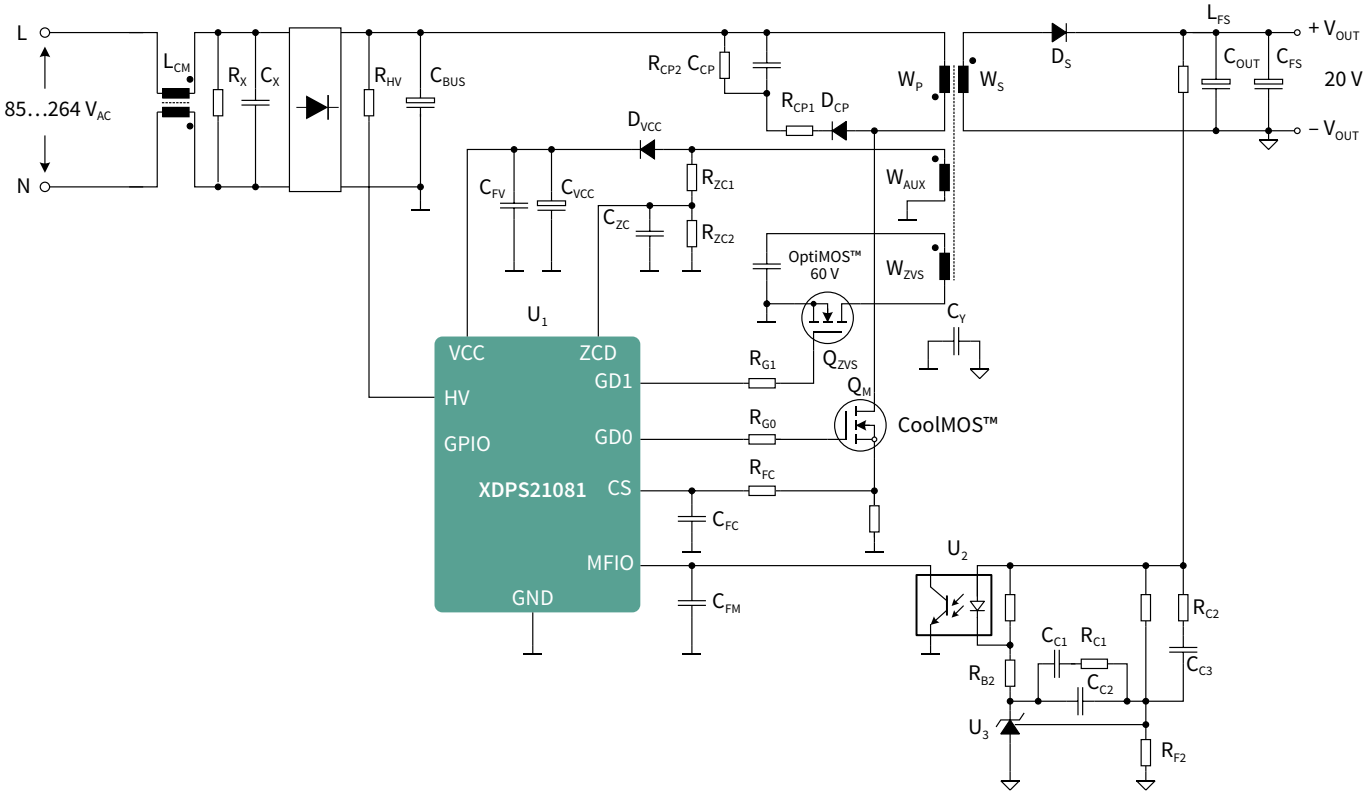
Recommended products for USB-C chargers

Funktional block	Product category	Topology	Product	Benefits
Flyback converter	High-voltage MOSFETs and HEMTs	Flyback	600 V/700 V/800 V CoolMOS™ P7 SJ MOSFETs	› Fast switching speed for improved efficiency and thermals › Reduced gate charge for enhanced light-load efficiency › Optimized gate-to-source voltage (VGS) threshold for lower turn-off losses
		ACF, FMCI	600 V CoolMOS™ PFD7 SJ MOSFETs	› Robustness and reliability with integrated robust fast body diode and up to 2 kV ESD protection › Reduced gate charge for enhanced light-load efficiency › Lower hysteresis loss
		Flyback (ACF, FFR, etc.)	CoolGaN™ 600 V e-mode HEMTs	› Highest efficiency › Highest power density
	Control ICs	FFR flyback IC	XDPS21071	› DCM operation with digital force-frequency resonant › Ideal for USB-PD
		FFR flyback IC	XDPS21081	› Optimization of low line AC input with forced quasi-resonant › Suitable for high power density design
		Hybrid flyback IC	XDPS2201	› Asymmetrical half-bridge ZVS control to maximize efficiency › Supports a wide range of configurable parameters › Supports Ultra-high power density (20W/in3) design
		QR flyback	PAG1P/S	› Secondary-side-controlled flyback solution › 2 chip flyback solution with integrated SR+PD controller
	Gate driver IC	Active-clamp flyback (ACF)	IRS25752L	› High-side gate driver enables active clamp mode of operation › Cost-effective, 600 V, single-channel driver in SOT23 package
			IRS21271S	› High-side gate driver enables active clamp mode of operation › 600 V, single-channel driver with over-current protection (OCP)
PFC DC-DC	High-voltage MOSFETs, HEMTs, and diodes	DCM PFC	600 V CoolMOS™ P7 SJ MOSFETs	› Fast switching speed for improved efficiency › Reduced gate charge for enhanced light load efficiency › Optimized gate-to-source voltage (VGS) threshold for lower turn-off losses
		DCM/CCM PFC	CoolGaN™ 600 V e-mode HEMTs	› Highest efficiency contribution via less parasitic parameter › Space saving with SMD smaller package
	Boost diode	DCM/PFC	650 V Rapid 1 diodes	› Low conduction losses
	Control ICs	DCM PFC ICs	TDA4863G, IRS2505LTRPBF	› Simple external circuitry › High PFC and low THD
		PFC/LLC Combo	IDP2308	› Digital multi-mode PFC and LLC combined controller with a floating high side driver and a startup cell › Comprehensive and configurable protection features › Wide set of configurable parameters
	High-voltage MOSFETs and HEMTs	HB LLC	600 V CoolMOS™ P7 SJ MOSFETs	› Fast switching speed for improved efficiency and thermals › Reduced gate charge for enhanced light load efficiency › Optimized gate-to-source voltage (VGS) threshold for lower turn-off losses
			CoolGaN™ 600 V integrated power stage (half-bridge)	› Highest efficiency and highest power density › Isolated gate driver integrated
	Gate driver IC	HB LLC	EiceDRIVER™ Compact: 1EDI60N12AF, 1ED3124MU12F	› Isolated gate driver, up to 14 A, 100 ns propagation delay
Synchronous rectification	Low-voltage MOSFETs	Synchronous rectification	OptiMOS™ PD 100-150 V	› Low conduction losses, reduced overshoot › Adapter-oriented synchronous rectification MOSFETs
	Control ICs	Synchronous rectification	IR1161LTRPBF	› High efficiency › Simple external circuitry
			PAG1S	› Integration of synchronous rectification and PD controller › Configurable protection, like OTP, OCP, OVP, UVP, short circuit, etc.
Protocol control	USB-C ICs	Protocol controller	PAG1S	› Supports USB PD2.0, PD 3.0 with PPS, QC4+, QC 4.0, QC 3.0,QC 2.0, Samsung AFC, Apple charging, and BC v1.2 charging protocols
		Protocol controller	EZ-PD™ CCG3PA-NFET	› Supports USB PD3.0 with Programmable Power Supply (PPS) › Independent constant current (CC) and constant voltage (CV) modes › Configurable OVP, OCP, and OTP › Integrates NFET gate driver to drive the load switch › 64KB Flash Memory
			EZ-PD™ CCG3PA	› Supports USB PD3.0 with PPS, QC4, Apple 2.4 A charging, AFC, BC1.2 etc. › Supports 1C and 1A port › 64 kB flash memory
		Multi-port controller	EZ-PD™ CCG7D multi-port controller	› Integrates 2 USB-C PD controllers + 2 DC-DC controllers in one single chip › Supports latest USB-C PD v3.0 with PPS, QC4+, QC4.0, Samsung AFC, Apple 2.4A, BCv1.2 › Configurable switching frequency of 150 kHZ- 600 kHZ › Arm® Cortex®-M0 with flash allows users to implement custom features

XDP™ digital power XDPS21081 – digital FQR flyback controller

The XDP™ digital power XDPS21081 is a flyback controller with ZVS (Zero Voltage Switching) on the primary side to achieve high efficiency with simplified circuitry and economical switches. By driving an external low voltage switch to induce a negative current to discharge the main high voltage MOSFET, switching losses can be reduced further than the traditional valley switching type of switching scheme. To achieve high efficiency with synchronous rectification, multi-mode digital forced quasi-resonant (FQR) flyback controller IC ensures DCM (discontinued conduction mode) operation for a safe and robust operation.

Typical application schematic



Key features	Key benefits
› Zero voltage switching › Frequency law optimization › Active burst mode operation with multi-entry/exit threshold › Integrated dual MOSFET gate driver › Easy ZVS implementation with an external 60 V MOSFET › CrCM operation with valley detection	› Reduce switching loss and achieve high efficiency › Optimize efficiency across various line/load condition › Optimize light and no-load efficiency › Save BOM count and cost with no messy external driver › Easy to drive, low cost ,and widely available off the shelf 60 V MOSFET › Fail-safe mechanism to limit output power in the event of PD controller failure

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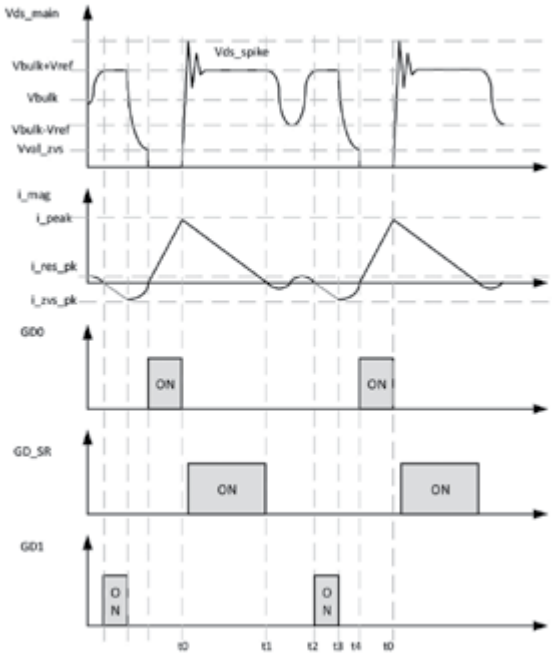
XDP™ digital power XDPS21081 – digital FQR flyback controller

The XDP™ digital power XDPS21081 is a flyback controller with zero voltage switching (ZVS), patented forced-frequency-resonant (FFR) switching operation on the primary side to achieve high efficiency with simplified circuitry and economical switches resulting in lower BOM cost.

FFR operation principle



After the primary MOSFET turns off at t_0, the synchronous rectifier (SR) MOSFET will turn-on, delayed by a short blanking time. At t_1, the SR MOSFET turns off when the demagnetizing current ideally goes to zero, then the magnetizing inductance L_p and C_{eqv} will oscillate. The voltage of the primary MOSFET will oscillate from $V_{bulk+Vref}$ to $V_{bulk-Vref}$. If the auxiliary MOSFET is turned on at t_2, the resonant peak of the primary MOSFET will mean the magnetizing current is zero, then the $i_{\_mag}$ will build up as negative. During this controlled ZVS on-time, the Vds of the primary MOSFET is clamped to $V_{bulk+Vref}$. Once the peak current reaches $i_{\_zvs\_pk}$, the aux MOSFET is turned off, and because this current is stored in the magnetizing inductance and in the reverse direction, it will continue to flow in this direction and discharge the energy stored in C_{eqv}. This time duration in the IC is controlled by the $t_{ZVSdead}$ parameter, which is configurable. So at t_4, the drain voltage of the primary MOSFET reaches its minimum, and turns on the primary MOSFET, which reduces the turn-on losses significantly, in fact it is almost ZVS. As seen in the diagram, the energy is proportional to V_{bulk}, and so is the ZVS on-time. ZVS pulse insertion is based on nano-DSP core and memory info. The IC knows the next switching cycle period and ZVS dead-time and ZVS pulse on-time, so the switching period minus these two parts will decide the ZVS pulse starting point, assuming the IC main gate turn-on time is also fixed. When the CS signal reaches the current command, the main gate off-point can also be decided.

65 W reference design with XDP™ XDPS21081

This is a 65 W charger reference design in a small form factor, developed to demonstrate the performance by meeting various regulatory limits as well as allowing for small form factor designs.

Featured products	
Primary PWM controller	XDPS21081
Primary MOSFET	IPL60R185C7
Secondary SR MOSFET	BSC0802LS
ZVS MOSFET	BSL606SN
PD IC	CYPD3174
Output switch	BSZ0910LS
S/R IC	3rd party

Technical specification	
Input voltage	90 V_{AC} ~ 265 V_{AC}
Input frequency	47~64 Hz
Output voltage/current	Variable V_{out} by PD protocol as: 20V/3.25A, 5V/3A, 9V/3A, 12V/3A, 15V/3A
Output power	65 W
Efficiency	EC COCV5 Tier2 and DOELV6
Input standby power	<70 mW @ no load
Board dimensions	60 x 28 x 25 mm^3 (L x W x H)
Power density (uncased)	25.4 W/in^3

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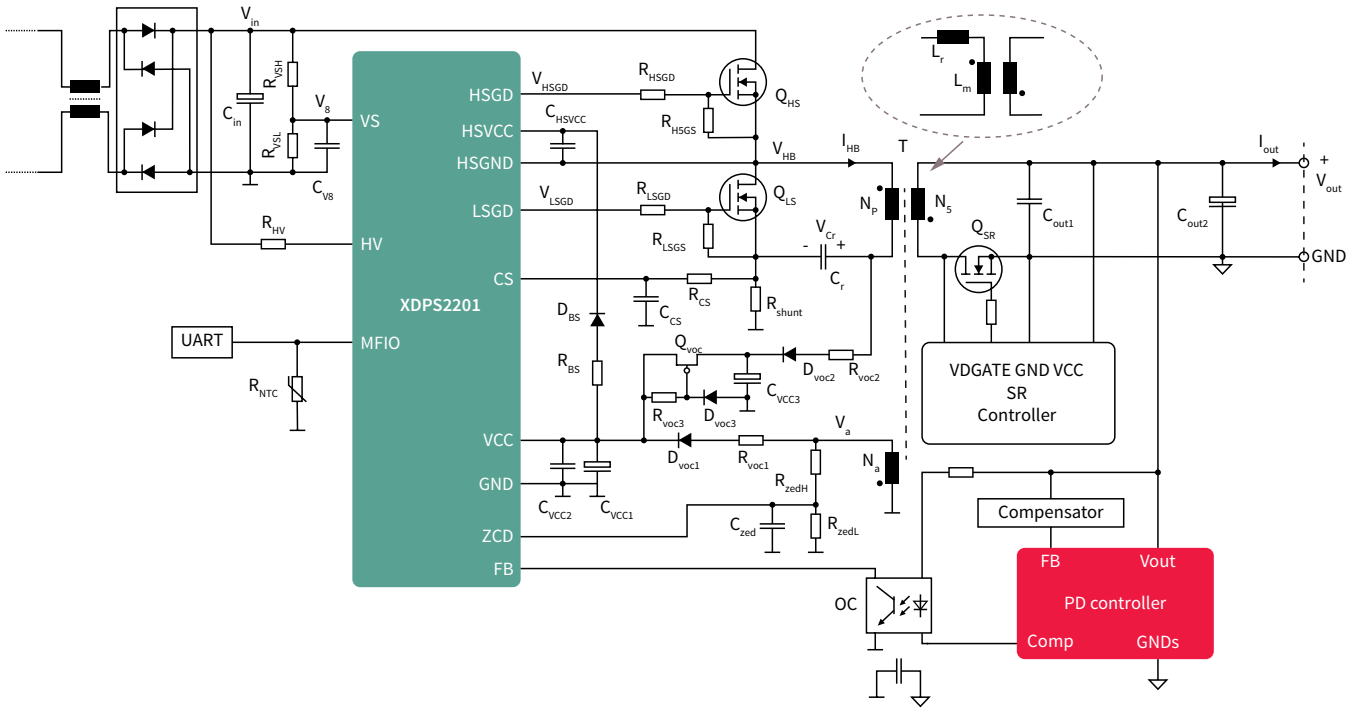
XDP™ digital power XDPS2201 – digital hybrid flyback controller

The XDPS2201 is a multi-mode, digital configurable hybrid flyback controller that combines the simplicity of a traditional flyback topology with the performance of a resonant converter. By utilizing two high-voltage MOSFETs, such as CoolMOS™, the controller can drive both high and low-side MOSFETs in an asymmetric half-bridge flyback topology. Both zero voltage and current switching are achieved through means of regulating the polarity of the magnetizing current to increase efficiency. In addition, transformer leakage energy is recycled and thereby further increases efficiency.

Typical application schematic



Key features

- Zero voltage and current switching across all line, and load conditions
- Multi-mode operation (active burst mode, DCM, ZV-RCS and CRM
- Integrated high-side driver and 600 V start-up cell
- Single auxiliary transformer winding and resonant cap to supply power to IC
- Comprehensive suite of protection feature sets
- Digital platform with configurable parameters

Key benefits

- Reduce switching loss and achieve high efficiency
- Optimize efficiency across various line/load condition
- Save BOM count and cost
- Simplified transformer design to support wide output voltage range
- Robust and safe design
- Optimize and/or scale system performance and behavior to the requirement

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65 W reference design with XDP™ XDPS2201

This is a 65 W USB-PD type C PPS charger demo board that uses Infineon XDPS2201 together with dual CoolMOS™ in a half-bridge configuration. It demonstrates high power density and high efficiency with both fixed and PPS output in an ultra-compact form factor supporting up to 65 W.

Featured products	
Primary PWM controller	XDPS2201
Primary MOSFETs	IPD60R180C7, IPP60R180C7
Secondary SR MOSFET	BSC093N15NS5
Load switch	BSZ086P03NS3
USB-PD IC	CYPD3174-24
Transformer	RM8
Bulk capacitor	100 uF

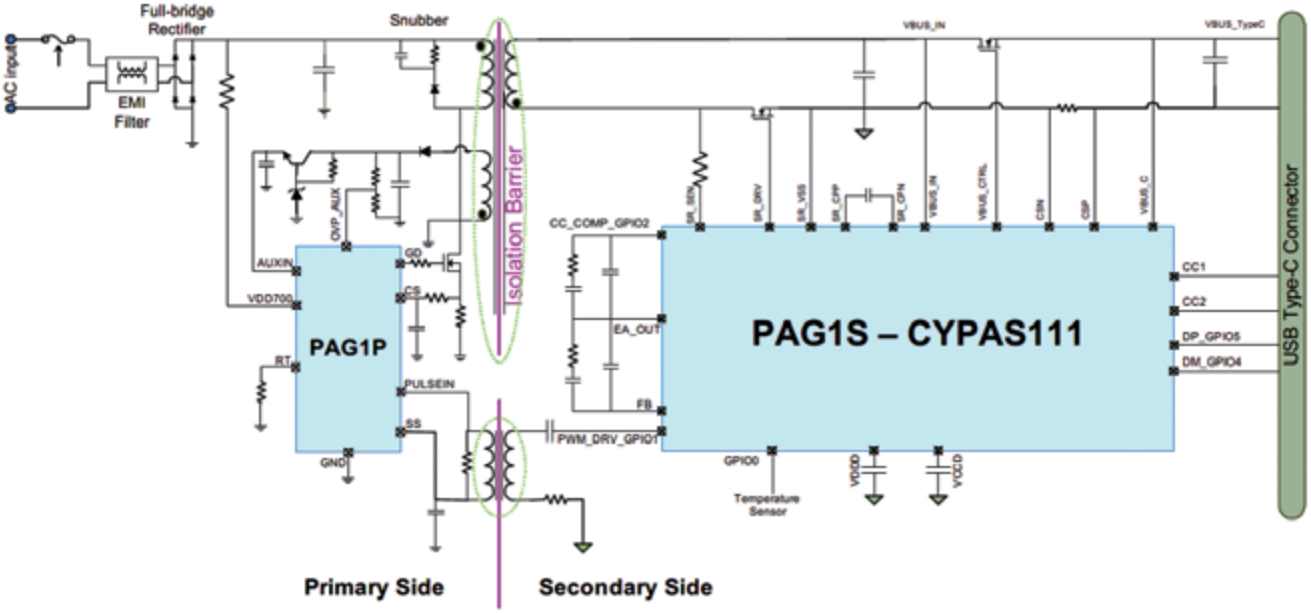
Technical specification	
Input voltage	90 V_{AC} ~ 265 V_{AC}
Input frequency	50/64 Hz
Output voltage/current	Variable V_{out} by PD protocol: 5 V, 9 V, 12 V, 15 V, 20 V & PPS: 5-20 V
Output power	65 W
Efficiency	@100 V_{AC} full power: 93.8%
Input standby power	<0.1 W
Board dimensions	37 x 43 x 19 mm^3 (L x W x H)
Power density (uncased)	31 W/in^3

2-chip solutions enabled by EZ-PD™ PAG1

Programmable 2-chip AC-DC solution that can scale power levels from 18 W to 65 W

- Single chip SR+PD controller
- Secondary-side controlled capable of QR/DCM with efficiencies of up to 92%
- Low standby power <30 mW

Typical application schmeatic



Parameter	18/20W (QR, DCM)	33W (QR, DCM)	45 W (QR, DCM)	65W (QR, DCM)
Dimension, mm	55x36x21	60x35x20	39 x 35.4 x 30.2 mm	52x42x22
Power density, W/inch³	7.8 (20W)	12,9	17.71	22,16
Standby power, mW (@230 V_{AC})	25	25	28	47
COC Power	Pass	Pass	Pass	Pass
Peak efficiency	89.27%	91.22%	91.85%	91.77%
Protection	OVP, UVP,OCP, SCP, OTP	OVP, UVP,OCP, SCP, OTP	OVP, UVP,OCP, SCP, OTP	OVP, UVP,OCP, SCP, OTP
CE/RE Passing	CE/RE[1]	CE	CE	CE
Release date	Available	Available	Available	Available

[1]CE- Conducted Emission, RE - Radiated Emission

EZ-PD™ PAG1P

The PAG1P is a primary start-up controller for AC/DC applications. It is designed to work with PAG1S in a secondary-side controlled AC/DC flyback converter topology where the voltage and current regulation is performed by PAG1S, and PAG1P provides the start-up function, drives the primary FET, and responds to the fault condition. The PAG1P also supports X-cap discharge-mode for better efficiency.

Key features

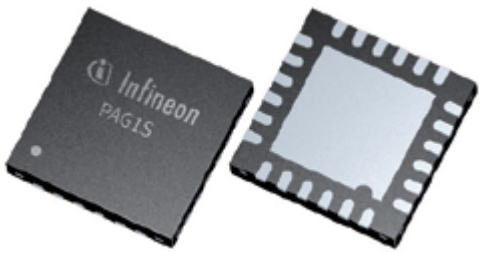
- Works across universal AC main input 85 V_{AC} to 265 V_{AC}
- Synchronizes to PWM from the secondary side using a pulse edge transformer
- Integrated low-side gate driver to drive primary side FET
- Integrated high-voltage start-up and shunt regulator
- Supports X-cap discharge mode for enhanced efficiency
- Integrated line UV, OCP, and secondary OVP
- Fixed auto-restart timer for fault recovery
- Programmable soft-start configurable with an external capacitor
- Available in a 10-SOIC package

EZ-PD™ PAG1S

The PAG1S is a single-chip, secondary-side controller that integrates the synchronous rectification driver, PD controller, and a wide range of protection circuits. The controller is designed to support a traditional primary controlled flyback architecture, as well as a more efficient secondary controlled flyback architecture with a simple primary start-up up controller. The PAG1S helps design world-class, high-performance power adapters at lower BOM costs.

Key features

- Works with both primary-side and secondary-side controlled flyback designs
- Integrates secondary-side regulation, synchronous rectifier (SR), and charging port controller
- Supports quasi-resonant (QR) or critical conduction mode (CrCM), valley switching, discontinuous conduction mode (DCM), and burst mode for light load operations
- Switching frequency range of 20 kHZ to 150 kHZ
- Higher efficiency across the line and load levels with independent CC/CV loop control
- Supports USB PD 3.0 with PPS (USB-IF certified, TID:1475), QC4+
- Supports legacy charging protocols: BC v1.2, AFC, and Apple charging
- Integrates low side current sense amplifier and V_{BUS} NFET gate drivers
- Available in a 24 QFN (4x4) package



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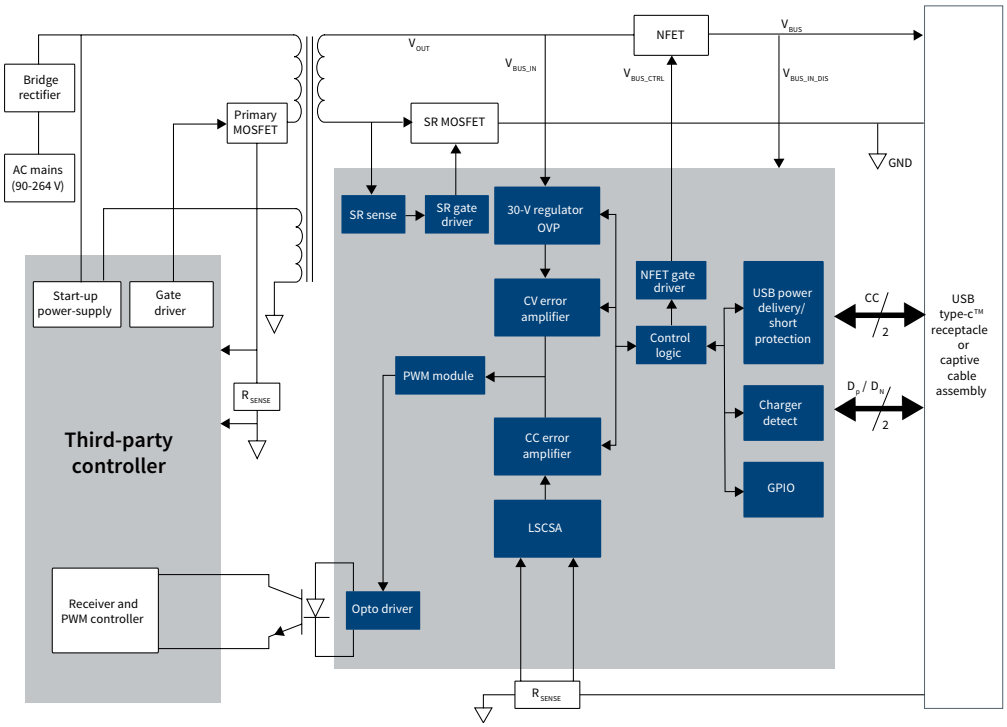
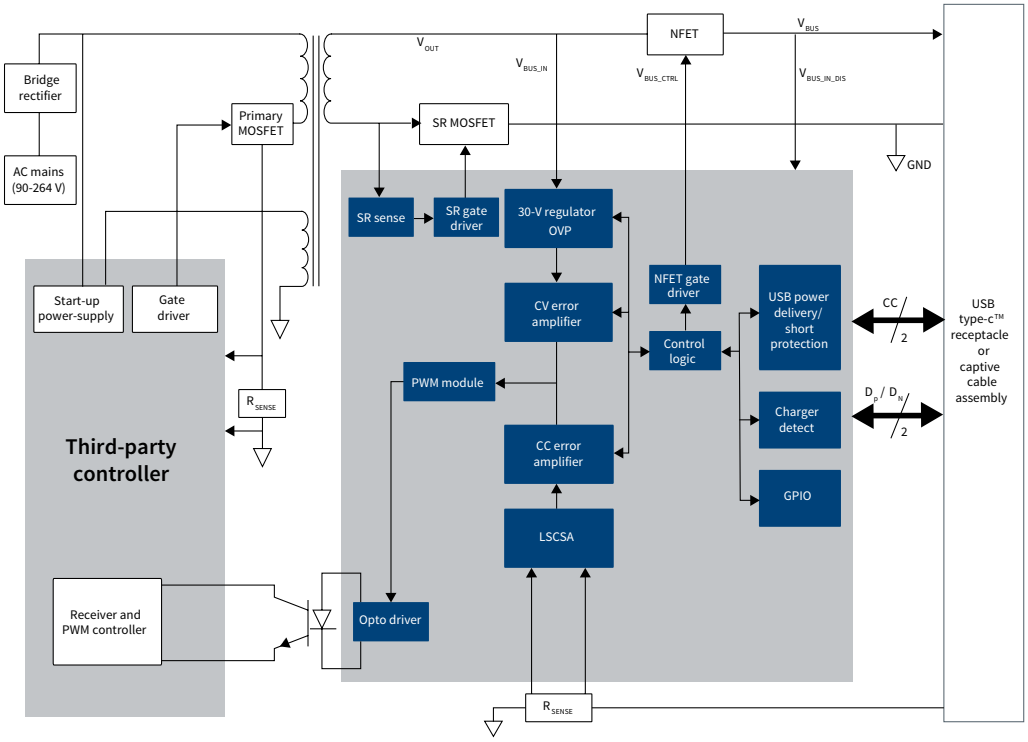
Design example - primary - controlled flyback solution



Design example - secondary - controlled flyback solution



Key benefits

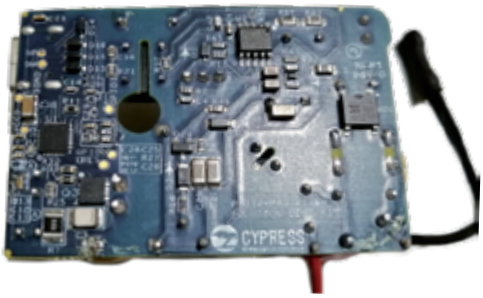
- PAG1 is a highly integrated 2 chip power adapter solution. It integrates SR+PD controller, all necessary protection circuitry, and FET drivers to drive the primary, SR, and Load FETs
- The PAG1 solution is built with ARM Cortex M0 and offers the flexibility to program the device as per the customer needs, configure the parameters across multiple platforms as well as upgrade the firmware on the field
- The PAG1 offers ready to use reference designs across power levels that work with all necessary regulatory compliances such as DoE Level VI, CoC Tier 2 and CISPR 32 class B

20 W reference design with EZ-PD™ PAG1S+P

This is a 20 W USB-PD type C PPS charger demo board that uses Infineon's PAG1S and PAG1P controllers along with InfineonMOSFETs. The solution meets the global efficiency standards including DoE Level VI/ CoC Tier 2 and offers a low standby power of <30 mW Together, PAG1S and PAG1P offer a low BOM cost and allow for high performance PD/ PPS/QC compliant solutions.

Featured products	
Primary PWM controller	CYPAP111A3-10SXQ
Primary MOSFETs	IPS70R900P7S
Secondary SR MOSFET	BSZ097N10NS5
Load switch	BSZ0902NS
USB-PD IC	CYPAS111A1-10SXQ
Transformer	RM7
Bulk capacitor	42 uF

Technical specification	
Input voltage	90 V_{AC} ~ 265 V_{AC}
Input frequency	47-63 Hz
Output voltage	Variable V_{OUT} by PD protocol: Fixed PDOs : 5 V/3 A, 9 V/2 A, 9 V/2.22 A PPS: 3.3–5.9 V/3 A, 3.3 – 11 V/1.81 A
Output power	18/20 W
Efficiency	EC COCV5 Tier2 and DOELV6 (Peak efficiency of 89.27%)
Standby power (no load)	<30 mW
Board dimensions	55 x 36 x 21 mm^3 (L x W x H)



33 W USB-PD/PPS reference design with EZ-PD™ PAG1S+P

This 33 W USB-PD type C PPS charger demo board comes along with the PAG1S and PAG1P controllers combined with Infineon 's high- and low-voltage MOSFETs. The solution meets the global efficiency standards including DoE Level VI/ CoC Tier 2 and is targeted for USB PD (including PPS), QC power adapters.

Featured products	
Primary PWM controller	CYPAP111A3-10SXQ
Primary MOSFETs	IPA70R600P7S
Secondary SR MOSFET	BSZ097N10NS
Load switch	BSZ0902NS
USB-PD+SR IC	CYPAS111A1-24LQXQ
Transformer	RM8
Bulk capacitor	59 uF

Technical specification	
Input voltage	90 V_{AC} ~ 265 V_{AC}
Input frequency	47-63 Hz
Output voltage	Variable V_{OUT} by PD protocol: Fixed: 5 V/3 A, 9 V/3 A PPS: 3.3 – 11 V/3 A
Output power	33 W
Efficiency	EC COCV5 Tier2 and DOELV6 (Peak efficiency of 91.22 %)
Standby power (no load)	<30 mW
Board dimensions	60 x 35 x 20 mm^3 (L x W x H)

45 W USB-PD/PPS reference design with EZ-PD™ PAG1S+P and CoolGaN™

This 45 W USB-PD type-C PPS reference design features Infineon's PAG1S and PAG1P controllers together with the CoolGaN™ 600 V e-mode HEMT. The solution meets the global efficiency standards including DoE Level VI/ CoC Tier 2 and offers a standby power as low as <30 mW.

Featured products	
Primary PWM controller	CYPAP111A3-10SXQ
Primary MOSFET	IGT60R070D1ATMA1
Secondary SR MOSFET	BSC160N15NS5ATMA1
V_{BUS} MOSFET	BSZ0902NS
PD+SR IC	CYPAS111A1-24LQXQ
Transformer	RM8
Bulk capacitor	94 uF

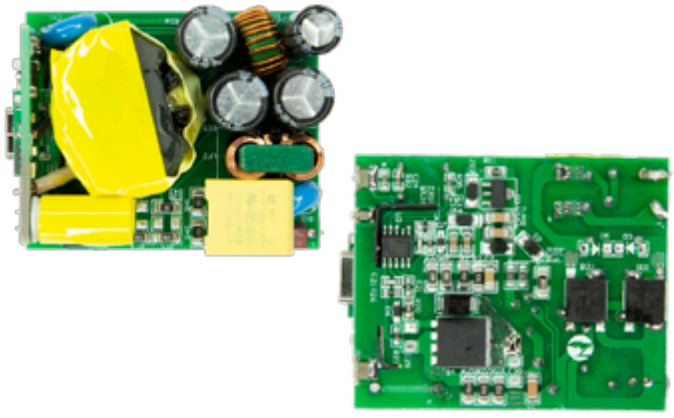
Technical specification	
Input voltage	90 V_{AC} ~ 265 V_{AC}
Input frequency	47-63 Hz
Output voltage/current	Fixed PDOs: 20 V/2.25 A, 15 V/3 A, 9 V/3 A, 5 V/3 A PPS PDOs: 3.3 – 21 V / 2.25 A
Output power	45 W
Efficiency	EC COCV5 Tier2 and DOELV6 (Peak efficiency of 91.85%)
Standby power	<30 mW
Power density (uncased)	17.71 W/in^3
Board dimensions	39 x 35.4 x 30.2 mm^3 (L x W x H)

65 W USB-PD/PPS reference design with EZ-PD™ PAG1S+P and CoolMOS™

Featured products	
Primary PWM controller	CYPAP111A3-10SXQ
Primary MOSFET	IPL60R185C7
Secondary SR MOSFET	BSC098N10NS5
V_{BUS} MOSFET	BSZ0902NS
PD+SR IC	CYPAS111A1-24LQXQ
Bulk capacitor	103 uF

Technical specification	
Input voltage	90 V_{AC} ~ 265 V_{AC}
Input frequency	47-63 Hz
Output voltage/current	Variable V_{OUT} by PD protocol as: Fixed PDOs: 20 V/3.25 A, 15 V/3 A, 12 V/3 A, 9 V/3 A, 5 V/3 A PPS PDOs : 3.3 – 21 V / 3 A
Output power	65 W
Efficiency	EC COCV5 Tier2 and DOELV6 (peak efficiency of 91.77%)
Input standby power	62 mW @ no load 265 V_{AC}
Power density (uncased)	22.16 W/in^3
Board dimensions	52 x 42 x 22 mm^3 (L x W x H)

The 65 W USB-PD type C PPS charger reference design features Infineon's PAG1S and PAG1P controllers along with Infineon's high-voltage CoolMOS™ superjunction MOSFET. The solution meets the global efficiency standards including DoE Level VI/ CoC Tier 2 and passes the conducted emission as per EN 55032 B standard.



EZ-PD™ CCG3PA

The EZ-PD™ CCG3PA is a single-chip USB type-C power delivery (PD) controller. The CCG3PA is ideal for applications such as power adapters, mobile chargers, power banks and car chargers. It integrates USB-C transceiver along with the termination resistors, an integrated feedback control circuitry for voltage (V_{BUS} regulation), a 30V-tolerant regulator, V_{BUS} to CC short protection, a high-voltage PFET gate driver and system level ESD protection. The CCG3PA is a fully programmable solution, that supports Power Delivery 3.0 Programmable Power Supply and Quick Charge 4.0 standards.

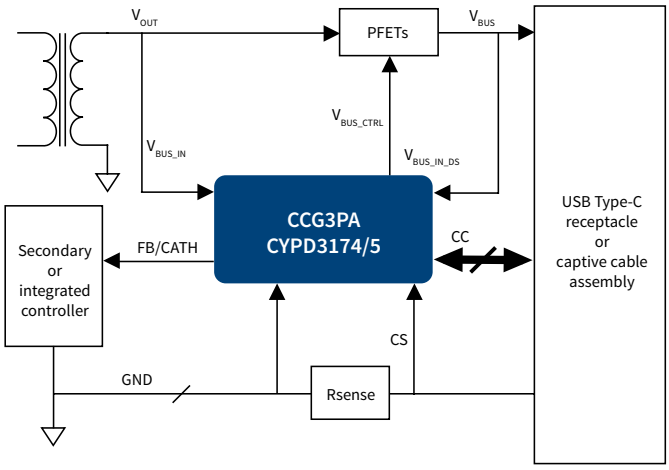
Key features

- Supports one USB type-C port and one type-A port
- Supports USB Power Delivery 3.0 PPS
- Supports the legacy protocols including Qualcomm QC 4.0, Apple charging 2.4 A, AFC, BC 1.2 at no additional BOM cost
- Programmable USB-C controller offering the flexibility to implement custom features and upgrade the firmware on the field
- Integrates voltage regulation and current sense amplifier
- Integrates 30 V-tolerant regulator
- On-chip OVP, OCP, UVP, SCP and V_{BUS} to CC short protection
- Integrates a PFET V_{BUS} gate driver
- Integrated system level ESD on V_{BUS}, CC and DP/DM
- Available in 24-pin QFN (16 mm2), 16-pin SOIC (60 mm^2) packages

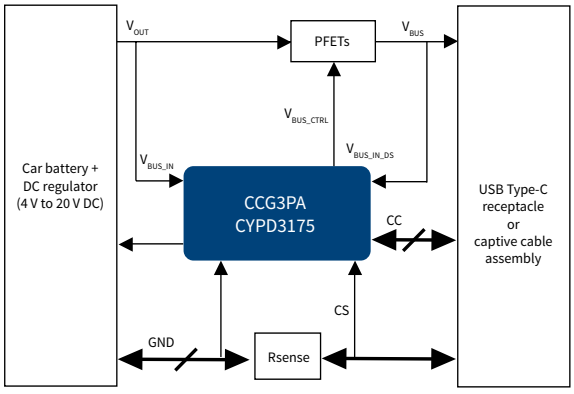
Key benefits

- Integrates 30 V-tolerant regulator, including V_{BUS} PFET gate drivers, OVP and OCP circuitry
- Integrates voltage regulation and low-side current sense to support PD3.0 PPS and QC4.0
- Supports PWM/I2C/GPIO interface to control V_{BUS}
- Integrates V_{BUS} to CC short protection and ESD protection

Mobile charger



Car charger



www.infineon.com/usb-pd

EZ-PD™ CCG3PA-NFET

EZ-PD™ CCG3PA-NFET is a highly-integrated USB type-C PD protocol controller that complies with the latest USB type-C and PD standards and is designed for power adapters. It offers significant BOM advantage by integrating all type-C port termination resistors, 24 V-tolerant regulator, a high voltage V_{BUS} NFET gate driver, V_{BUS} to CC short protection, and an integrated feedback circuitry for voltage (V_{BUS}) regulation.

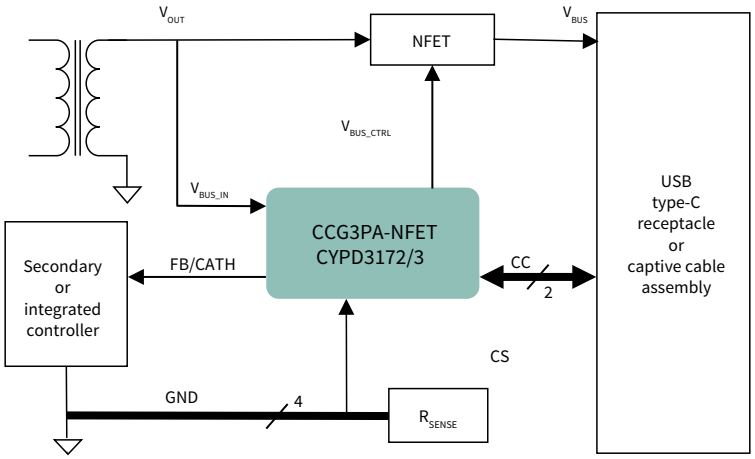
Key features

- Supports one USB Type-C port
- Supports USB Power Delivery 3.0 PPS
- Supports the legacy protocols including Qualcomm QC 4.0, Apple charging 2.4A, AFC, BC 1.2 at no additional BOM cost
- Independent CC-CV loop
- Integrates V_{BUS} NFET gate driver
- Programmable USB-C controller offering the flexibility to implement custom features and upgrade the firmware on the field
- On-chip OVP, OCP, UVP, SCP and V_{BUS} to CC Short protection
- Available in 24-pin QFN (16 mm2[2] package)

Key benefits

- Provides type-C solution with power delivery 3.0 (PD 3.0) with programmable power supply support and quick charge 4.0 (QC 4.0)
- Includes an Arm® Cortex®-M0 and certified USB-PD stack
- Integrates voltage regulation, 24-V-tolerant regulator, V_{BUS}-to-CC short protection and high-voltage NFET gate driver
- Supports field upgrades with free, fully-compliant firmware

Primary-side controlled power adapter solution



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CoolMOS™ high-voltage superjunction MOSFETs

Manufacturers of slimmer and lighter chargers require cost-effective MOSFETs in small packages that feature good electromagnetic interference (EMI) and excellent thermal performance, enabling high efficiency and low standby power. Infineon offers a wide range of high-voltage superjunction MOSFETs. For example, the CoolMOS™ P7 family, which combines high efficiency and optimized cost with ease of use.

600 V CoolMOS™ P7

- Most balanced technology of all CoolMOS™ families
- Integrated Zener diode
- Highest efficiency
- Excellent ease of use and commutation ruggedness
- Competitive price

700 V/800 V CoolMOS™ P7

- Price competitiveness compared to similar competitor technologies
- Supports increased switching frequency to reduce magnetics
- Integrated Zener diode
- Best fit for target applications in terms of
  - Thermals and efficiency
  - Ease of use level

600 V CoolMOS™ PDF7

- Minimizing switching and hysteresis losses
- BOM cost reduction and easy manufacturing
- Robustness and reliability
  - Integrated Zener Diode
  - Up to 2 kV ESD protection

600 V/650 V CoolMOS™ C7

- High switching performance enabling highest efficiency
- Ease of use level high
- Optimized devices for highest efficiency switched-mode power supplies

Soft-switching techniques enable devices to operate in ZVS, which means that the MOSFET is turned on only after its drain-source voltage reaches 0 V (or a value close to 0 V). This strategy eliminates the turn-on loss of the device, which is typically the major contributor to the overall switching loss. Unfortunately, all high-voltage SJ MOSFETs suffer from another type of loss due to their "non-lossless" behavior of the output capacitance. This means that when the MOSFET output capacitance (C_{oss}) is charged and subsequently discharged, some energy will be lost. Therefore, even when operating under ZVS conditions, all the energy stored in the output capacitance (E_{oss}) will not be recovered. This phenomenon is related to the hysteretic behavior of the C_{oss}, as shown below, which can be observed performing a C_{oss} charge/discharge cycle with a large signal measurement. This is why these losses are commonly known as Coss hysteresis losses ($E_{oss,hys}$). CoolMOS™ C7 series well reduce switching loss and hysteresis losses to maximize efficiency.

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600 V CoolMOS™ P7

The 600 V CoolMOS™ P7 superjunction (SJ) MOSFET family is a general purpose series, targeting a broad variety of applications, amongst them chargers & adapters. The feature of an excellent ESD capability helps to improve the quality in manufacturing. It offers a wide range of $R_{DS(on)}$/package combinations, including THD, as well as SMD devices, at an $R_{DS(on)}$ granularity from 24 mΩ to 600 mΩ . The excellent ease-of-use level of the 600 V CoolMOS™ P7 results from carefully selected integrated gate resistors.

600 V CoolMOS™ P7: recommended products for chargers & adapters

$R_{DS(on)}$ [mΩ]	FullPAK narrow lead 	ThinPAK 8x8 	DPAK 
125		IPL60R125P7	
180/185	IPAN60R180P7S	IPL60R185P7	IPD60R180P7S
280/285	IPAN60R280P7S	IPL60R285P7	IPD60R280P7S
360/365	IPAN60R360P7S	IPL60R365P7	IPD60R360P7S
600	IPAN60R600P7S		IPD60R600P7S

600 V/650 V CoolMOS™ C7: recommended products for chargers & adapters

$R_{DS(on)}$ [mΩ]	600 V CoolMOS™ C7 in ThinPAK 8x8 	650 V CoolMOS™ C7 in ThinPAK 8x8 
125/130	IPL60R125C7	IPL65R130C7
185/195	IPL60R185C7	IPL65R195C7
230		IPL65R230C7

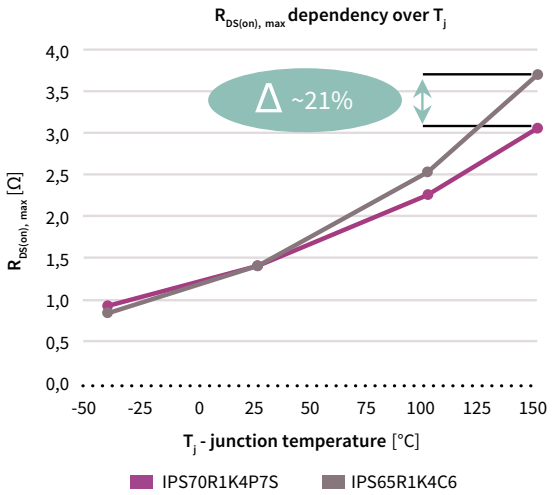
Increased switching performance, enabling highest efficiency in charger & adapter applications is amongst the key benefits of the 600 V and 650 V CoolMOS™ C7 families. These product families keep the ease-of-use level high and are optimized devices for highest efficiency switched mode power supplies.

www.infineon.com/usb-pd

700 V CoolMOS™ P7

The 700 V CoolMOS™ P7 family has been developed to serve today's and, especially, tomorrow's trends in flyback topologies. The series balances cost and performance, helping to improve overall competency.

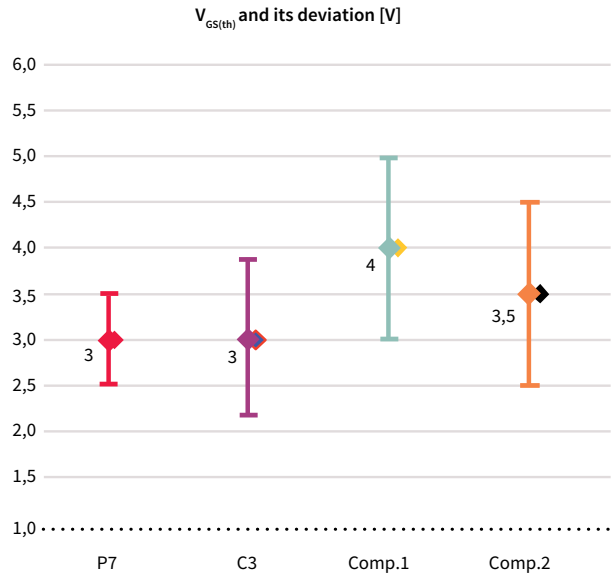
Best-in-class $R_{DS(on)}$ dependency over T_j



Customer benefits

- Lower $R_{DS(on)}$ increase with increasing junction temp.
- Lower $R_{DS(on)}$ increase with increasing junction temperature leads to reduced conduction losses at target applications

Best-in-class $V_{GS(th)}$ and lowest $V_{GS(th)}$ tolerance



Customer benefits

Keeping the ease of use in mind, Infineon has developed the technology with a low threshold voltage ($V_{GS(th)}$) of 3 V and a very narrow tolerance of ±0.5 V. This makes the CoolMOS™ P7 easy to design-in and enables the usage of lower gate source voltage, which facilitates its driving and leads to lower idle losses. To increase the ESD ruggedness up to HBM class 2 level, 700 V CoolMOS™ P7 has an integrated Zener diode. This helps to support increased assembly yield, leads to reduction of production related failures and, finally, manufacturing cost savings on customer side.

Key features

- Highly performant technology
  - Low switching losses (Eoss)
  - Highly efficient
  - Excellent thermal behavior
- Allowing high speed switching
- Integrated protection Zener diode
- Optimized $V_{GS(th)}$ of 3 V with very narrow tolerance of ±0.5 V
- Finely graduated portfolio

Key benefits

- Cost-competitive technology
- Further efficiency gain at higher switching speed
- Supporting less magnetic size with lower BOM costs
- High ESD ruggedness up to HBM class 2 level
- Easy to drive and design-in
- Enabler for smaller form factors and high power density designs
- Excellent choice in selecting the best fitting product

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700 V CoolMOS™ P7: recommended products for chargers & adapters

$R_{DS(on)}$ [mΩ]	FullPAK narrow lead 	DPAK 	SOT-223 
360	IPAN70R360P7S	IPD70R360P7S	IPN70R360P7S
600	IPAN70R600P7S	IPD70R600P7S	IPN70R600P7S
900		IPD70R900P7S	IPN70R900P7S
1400		IPD70R1K4P7S	IPN70R1K4P7S

800 V CoolMOS™ P7

The 800 V CoolMOS™ P7 series combines best-in-class performance with state-of-the-art ease-of-use. It is a perfect fit for flyback-based low-power SMPS applications, fully addressing market needs in performance, ease-of-use, and price/performance ratio. This product family has been fully optimized in key parameters to deliver best-in-class efficiency and thermal performance. In addition, lowest $R_{DS(on)}$ packages enable high power density.

CoolMOS™ P7 delivers exceptional ease-of-use. The integrated Zener diode ESD protection ensures ESD ruggedness up to class 2 for HBM mode, while $V_{GS(th)}$ optimization makes CoolMOS™ P7 easy to drive and to design-in.

800 V CoolMOS™ P7: recommended products for chargers & adapters

$R_{DS(on)}$ [mΩ]	FullPAK narrow lead 	DPAK 	SOT-223 
360	IPAN80R360P7	IPD80R360P7	IPN80R360P7
600	IPAN80R600P7	IPD80R600P7	IPN80R600P7
900		IPD80R900P7	IPN80R900P7
1400		IPD80R1K4P7	IPN80R1K4P7

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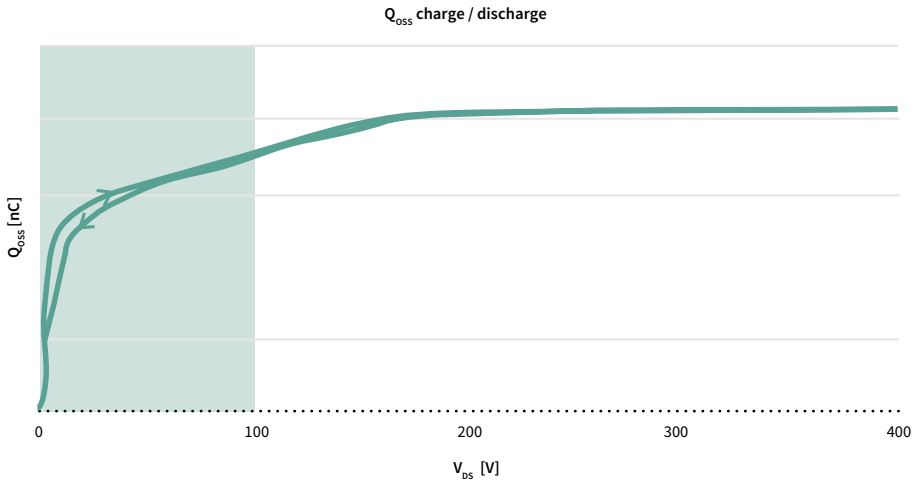
600 V CoolMOS™ PFD7

The latest 600 V CoolMOS™ PFD7 series sets a new benchmark in 600 V superjunction (SJ) technologies suitable for ultrahigh power density designs like chargers and adapters. This product family offers up to 1.17 % efficiency increase compared to the CoolMOS™ P7 technologies, which leads to a power density increase of 1.8 W. This outstanding improvement is achieved by lower conduction and charge/discharge losses, as well as reduced turn-off and gate-driving losses, enabled by pushing the cutting-edge CoolMOS™ technology to new limits.



Charging and discharging the MOSFET output papacitor is not lossless.

Thanks to the latest advancements in Infineon's state-of-the-art superjunction technology, the 600 V CoolMOS™ PFD7 series has lower hysteresis losses than previous generations, helping to further improve the efficiency.

600 V CoolMOS™ PFD7: recommended products for chargers & adapters

	ThinPAK 5x6	DPAK	SOT-223
$R_{DS(on)}$ [mΩ]			
360	IPLK60R360PFD7	IPD60R360PFD7	IPN60R360PFD7
600	IPLK60R600PFD7	IPD60R600PFD7	IPN60R600PFD7
900	IPLK60R1K0PFD7	IPD60R1K0PFD7	IPN60R1K0PFD7

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CoolMOS™ SJ MOSFET packages for charger & adapter applications

In charger designs, the total loop inductance of the MOSFET (consisting of the gate-source and drain-source inductances) is important to prevent the MOSFET from turning on again and also to reduce EMI. Compared to the DPAK or the FullPAK THD packages, ThinPAK offers a reduction in gate-, drain- and source inductances. Compared with the DPAK package, the internal source inductance of the ThinPAK is also reduced, by 63 percent.

To reduce the ringing on the gate of the MOSFET, the total gate-source inductance ($L_{gate\_loop} = L_{source} + L_{gate}$) is important. When the LC resonant tank is formed by the gate capacitance (C_{iss}) and the total gate loop inductance ($L_{source\_ext.} + L_{gate\_loop}$) is excited by a square wave driving waveform, this can cause ringing on the gate of the MOSFET. By reducing the total L_{gate_loop}, the amount of ringing seen on the gate of the MOSFET can be reduced.

Solution for slim and small adapters and chargers

ThinPAK 5x6

ThinPAK 5x6 reduces the PCB area by 52 percent and height by 54 percent when compared to the DPAK package which is widely used in chargers and adapters. Also, ThinPAK 5x6 enables a reduced charger and adapter case hot spot temperature by increasing the space between the MOSFET and the charger and adapter case.

Enabling significant space savings

ThinPAK 8x8

With a very small footprint of only 64 mm² (vs. 150 mm² for the D²PAK) and a very low profile with only 1 mm height (vs. 4.4 mm for the D²PAK) the ThinPAK 8x8 leadless SMD package for high voltage MOSFETs is a first choice to decrease system size in power-density driven designs. Low parasitic inductance and a separate 4-pin Kelvin source connection offer the best efficiency and ease of use. The package is RoHS compliant with halogen-free mold compound.

Solution for height reduction in adapters and chargers

TO-220 FullPAK Narrow Lead

Infineon's TO-220 FullPAK Narrow Lead addresses customer needs with regards to height reduction requirements in adapter and charger applications. By offering an optimized standoff width and height and improved creepage distance, the package can be fully inserted into the PCB without any production concerns and, therefore, is especially suitable for slim and semi-slim adapter solutions.

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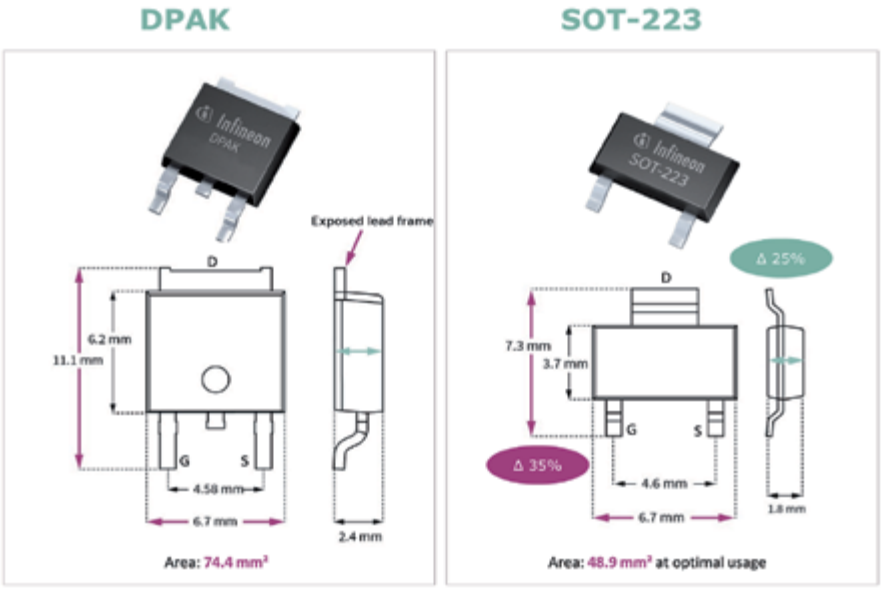
CoolMOS™ SJ MOSFET packages for charger & adapter applications

The cost-effective drop-in replacement for DPAK

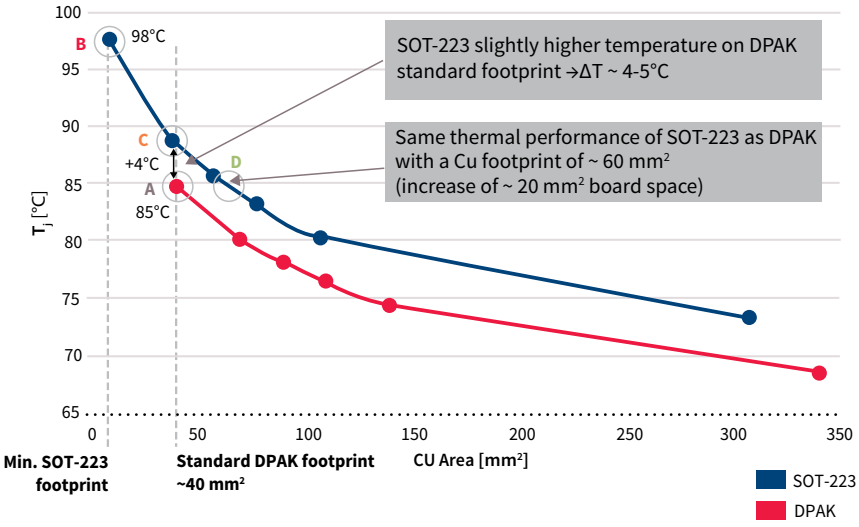
SOT-223

The SOT-223 package without a middle pin is a cost-effective alternative to DPAK, addressing the need for cost reductions in price- sensitive applications. It offers a smaller footprint, while still being pin-to-pin compatible with DPAK, thus, allowing a drop-in replacement for DPAK and second sourcing. Moreover, SOT-223 achieves comparable thermal performance to DPAK and enables customers to achieve improved form factors or space savings in designs with low power dissipation.

The figure on the right side shows a comparison of the dimensions of the DPAK and SOT-223 packages, the leads of the SOT-223 package will fit directly on the DPAK footprint. This common footprint means that the SOT-223 can easily be used as a direct replacement in existing PCB designs. The SOT-223 comes with a size advantage because it has a 25 percent lower package height and 35 percent shorter package length than the DPAK package. The SOT-223 can achieve similar thermal dissipation performance if the copper area is increased, e.g. by at least 20 mm² to 40 mm², the operating temperature of the SOT-223 device will drop to the same level as the DPAK device.



With the SOT-223 package, designers and engineers have a MOSFET choice that provides an excellent balance between performance, ease-of-use, small application footprint, and price.



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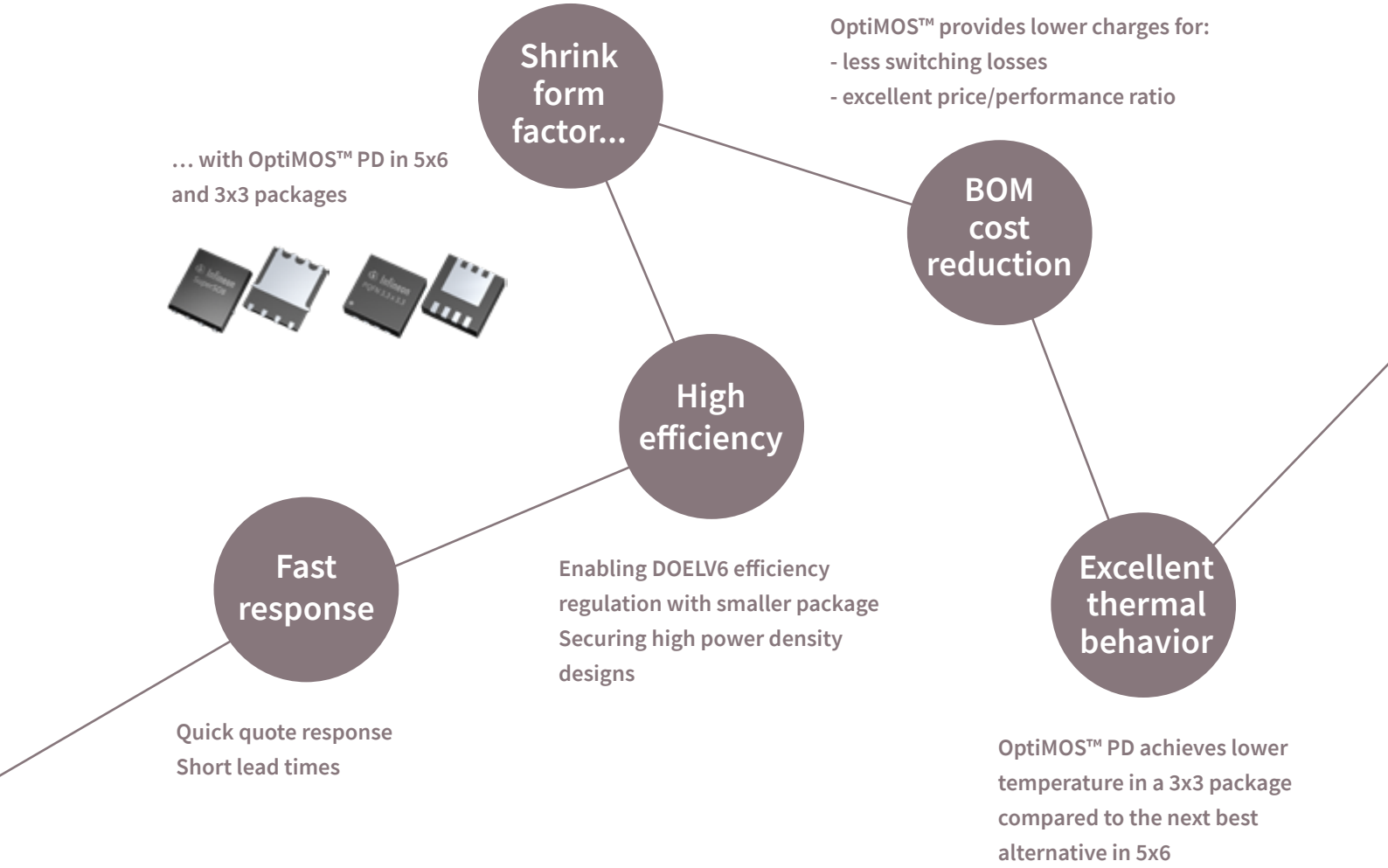
OptiMOS™ PD

The tailor-made portfolio for USB-PD sync rectification

Infineon's OptiMOS™ PD low-voltage MOSFET portfolio represents the best fit for USB power delivery and fast charger designs.
OptiMOS™ PD power MOSFETs in PQFN 3.3x3.3 and SuperSO8 packages are optimized for synchronous rectification in charger and adapter SMPS applications. The small package sizes translates into shrinking form factors.

Key features	Key benefits	Value proposition to designers	Value proposition to end customers
Logic Level availability: low threshold voltage	Parts fully driven from 4.5 V or directly from microcontroller → Less parts count	Designs with lower BOM cost	Less costly high quality products
Low on-state resistance ($R_{DS(on)}$) without increasing charges	Lower overall losses	Highest efficiency and power density designs	Compact, lightweight, environmentally friendly products
Low charges – gate, output and recovery	Lower switching losses	BOM cost reduction	Excellent price/performance ratio
Small standard packages (PQFN 3.3x3.3, SSO8)	Space saving packages	Designs with low form factor	More compact products



OptiMOS™ PD: selected highlight products for synch rect in chargers & adapters

	V_{DS}	$R_{DS(on)}$ max. @VGS = 4.5V [mΩ]	Package	Power
ISC0702NLS	60 V	2.8mΩ	PQFN 5x6	5V/5A;10V/5A
ISC0703NLS	60 V	6.5mΩ	PQFN 5x6	5V/5A
ISZ0702NLS	60 V	4.5mΩ	PQFN 3x3	5V/5A
BSZ0602LS	80 V	7.0mΩ	PQFN 3x3	10V/5A
BSC0802LS	100 V	3.4mΩ	PQFN 5x6	10V/5A; 100W PD
BSC0805LS	100 V	7.0mΩ	PQFN 5x6	65W PD
BSC0804LS	100 V	9.6mΩ	PQFN 5x6	45W/65W PD
BSZ0804LS	100 V	9.6mΩ	PQFN 3x3	45W/65W PD
BSC0402NS	150 V	9.3mΩ	PQFN 5x6	65W/100W PD
BSC0302LS	120 V	8 mΩ	PQFN 5x6	65W/100W PD

OptiMOS™ PD: selected highlight products serving as loading switch in chargers & adapters

	V_{DS}	$R_{DS(on)}$ max. @VGS = 4.5V [mΩ]	Package	Power
BSZ0909LS	30 V	3.0 mΩ	PQFN 3x3	5V/5A; 10V/5A
BSZ0910LS	30 V	5.7 mΩ	PQFN 3x3	5V/5A; 10V/5A; USB-PD
BSZ0911LS	30 V	7.0 mΩ	PQFN 3x3	USB-PD

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Power MOSFET recommendation for ≤ 65 W

Primary side	V_{DS}	$R_{DS(on)}$	Package	Power
IPN70R1K4P7S	700 V	1.4 mΩ	SOT-223	18 W
IPN70R900P7S	700 V	0.9 mΩ	SOT-223	33 W
IPN70R600P7S	700 V	0.6 mΩ	SOT-223	45 W
IPAN70R600P7S	700 V	0.6 mΩ	TO-220F	45 W
IPL60R365P7	600 V	0.365 mΩ	ThinPAK 8x8	45/65 W
IPN70R360P7S	700 V	0.36 mΩ	SOT-223	65 W
IPD70R600P7S	700 V	0.6 mΩ	TO-252	65 W
IPAN70R360P7S	700 V	0.36 mΩ	TO-220F narrow lead	65 W
IPL60R185C7	600 V	0.185 mΩ	ThinPAK 8x8	65 W
IPL60R185P7	600 V	0.185 mΩ	ThinPAK 8x8	65 W

Sync Rect	V_{DS}	$R_{DS(on)}$	Package	Power
ISC0702NLS	60 V	2.8 mΩ	PQFN 5x6	5 V/5 A;10 V/5 A
ISC0703NLS	60 V	6.5 mΩ	PQFN 5x6	5 V/5 A
ISZ0702NLS	60 V	4.5 mΩ	PQFN 3x3	5 V/5 A
BSZ0602LS	80 V	7.0 mΩ	PQFN 3x3	10 V/5 A
BSC0802LS	100 V	3.4 mΩ	PQFN 5x6	10 V/5 A; 100 W PD
BSC0805LS	100 V	7.0 mΩ	PQFN 5x6	65 W PD
BSC0804LS	100 V	9.6 mΩ	PQFN 5x6	45 W/65 W PD
BSZ0804LS	100 V	9.6 mΩ	PQFN 3x3	45 W/65 W PD
BSC0402NS	150 V	9.3 mΩ	PQFN 5x6	65 W/100 W PD
BSC0302LS	120 V	8 mΩ	PQFN 5x6	65 W/100 W PD

Loading switch	V_{DS}	$R_{DS(on)}$	Package	Power
BSZ0909LS	30 V	3.0 mΩ	PQFN 3x3	5 V/5 A; 10 V/5 A
BSZ0910LS	30 V	5.7 mΩ	PQFN 3x3	5 V/5 A; 10 V/5 A; USB-PD
BSZ0911LS	30 V	7.0 mΩ	PQFN 3x3	USB-PD

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Power MOSFET recommendation for > 75 W

PFC	V_{DS}	$R_{DS(on)}$	Package	Topology
IPD60R180P7S	600 V	0.18 mΩ	TO-252	PFC
IPAN60R280P7S	600 V	0.28 mΩ	TO-220F	PFC
IPAN60R180P7S	600 V	0.18 mΩ	TO-220F	PFC
IPL60R185C7	600 V	0.185 mΩ	ThinPAK 8x8	PFC
IPL60R125C7	600 V	0.125 mΩ	ThinPAK 8x8	PFC

Flyback or half-bridge	V_{DS}	$R_{DS(on)}$	Package	Topology
IPD60R360P7S	600 V	0.36 mΩ	TO-252	ACF, LLC
IPAN60R600P7S	600 V	0.60 mΩ	TO-220F	ACF, LLC
IPAN60R360P7S	600 V	0.36 mΩ	TO-220F	ACF, LLC
IPL60R365P7	600 V	0.365 mΩ	ThinPAK 8x8	ACF, LLC
IPLK60R360PFD7	600 V	0.36 mΩ	ThinPAK 5x6	ACF, LLC
IPAN70R360P7S	700 V	0.36 mΩ	TO-220F	Flyback
IPA65R225C7	650 V	0.225 mΩ	TO-220F	Flyback
IPL65R230C7	650 V	0.23 mΩ	ThinPAK 8x8	Flyback
IPL65R195C7	650 V	0.195 mΩ	ThinPAK 8x8	Flyback
IPD65R190C7	650 V	0.19 mΩ	TO-252	Flyback

Sync Rect	V_{DS}	$R_{DS(on)}$	Package
ISC0702NLS	60 V	2.8 mΩ	PQFN 5x6
ISC0703NLS	60 V	6.5 mΩ	PQFN 5x6
ISZ0702NLS	60 V	4.5 mΩ	PQFN 3x3
BSZ0602LS	80 V	7.0 mΩ	PQFN 3x3
BSC0802LS	100 V	3.4 mΩ	PQFN 5x6
BSC0805LS	100 V	7.0 mΩ	PQFN 5x6
BSC0302LS	120 V	8 mΩ	PQFN 5x6
BSC0402NS	150 V	9.3 mΩ	PQFN 5x6

Loading switch	V_{DS}	$R_{DS(on)}$	Package
BSZ0909LS	30 V	3.0 mΩ	PQFN 3x3
BSZ0910LS	30 V	5.7 mΩ	PQFN 3x3
BSZ0911LS	30 V	7.0 mΩ	PQFN 3x3

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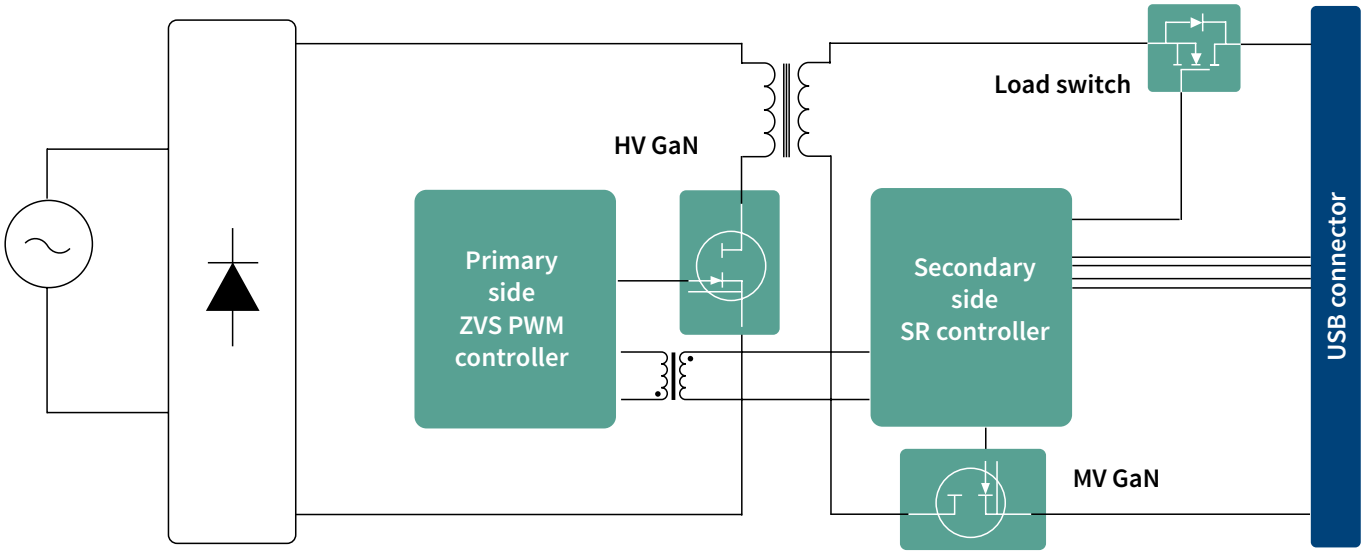
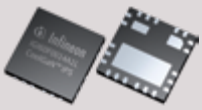
The full gallium nitride solution for USB-C chargers & adapters

Gallium nitride (GaN) offers fundamental advantages over silicon. In particular, the higher critical electrical field makes it very attractive for power semiconductor devices with outstanding specific dynamic on-state resistance and smaller capacitances compared to silicon MOSFETs, which makes GaN HEMTs great for high speed switching. Not only because of the resulting power savings and total system cost reduction, it also allows a higher operating frequency, improves the power density as well as the overall system efficiency.

Application diagram



Product		Part number	Package
	CoolGaN™ 600 V e-mode HEMT	IGLD60R190D1S	PG-LSON-8-1
	CoolGaN™ integrated power stage (single HEMT + driver)	IGI60F0014A1L	PG-LIQFN-21-1
	CoolGaN™ integrated power stage (half-bridge + driver)	IGI60F1414A1L	PG-TIQFN-28-1
	CoolGaN™ 100 V e-mode HEMT	IQC0800NLS	PQFN 3x5

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CoolGaN™ Integrated Power Stage (IPS) 600 V half-bridge

Ease of use with integrated drivers for highest efficiency and power density

The IGI60F1414A1L combines a half-bridge power stage consisting of two 140 mΩ (typ. $R_{DS(on)}$) / 600 V enhancement-mode CoolGaN™ switches with dedicated gate drivers in a thermally enhanced 8 x 8 mm QFN-28 package. It is thus ideally suited to support the design of compact appliances in the low-to-medium power area.

Infineon's CoolGaN™ provides a very robust gate structure. When driven by a continuous gate current of a few mA in the "on" state, a minimum on-resistance $R_{DS(on)}$ is always guaranteed, independent of temperature and parameter variations. Due to the GaN-specific low threshold voltage and the fast switching transients, a negative gate drive voltage is required in certain applications to avoid spurious turn-on effects. This can be achieved by the well-known RC interface between driver and switch. A few external SMD resistors and capacitors would enable easy adaptation to different applications (low/medium power, hard/soft switching).

The driver utilizes an on-chip coreless transformer (CT) technology to achieve level-shifting to the high side. Besides, CT guarantees excellent robustness even for extremely fast switching transients above 150 V/ns.

CoolGaN™ IPS provides:

- Smaller form factor
- Lighter designs
- Higher efficiency

Key features	Key benefits
› Digital-in, power-out building block › Application configurable switching behavior › Highly accurate and stable timing › Thermally enhanced 8 x 8 mm QFN-28 package	› Easy to drive with 2x digital PWM Input › Configurability of gate path with low inductance loop on PCB › Allows short dead-time setting in order to maximize system efficiency › Small package for compact system designs

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We are the link between the real and the digital world.

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We partner
We innovate
We perform

Our mission

We make life easier, safer and greener.

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