



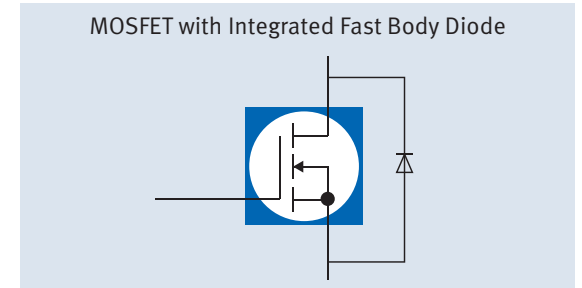
600V/650V CoolMOS™ Fast Body Diode Series (CFD/CFD2/CFDA)

# CFD2 technology

CoolMOST™ CFD2 is Infineon's second generation fast switching superjunction MOSFETs with integrated Fast Body Diode offering improved Energy Efficiency. It is the best choice for resonant switching topologies in applications like Telecom, Server, Battery Charging, Solar, HID Lamp Ballast and LED Lighting.

## Why is there a need for a Fast Body Diode?

Most resonant circuits are half or full bridge topologies (2 or 4 transistors). As transistors are switched on and off, energy can be left in the transistor. If due to fast transition times this happens continually then a Fast Body Diode is required to make sure all the energy will leave the transistor and avoid failures (CFD/CFD2/CFDA series).



## What is the difference between the CoolMOST™ CFD & CFD2 series?

CoolMOST™ CFD2 series was designed as direct replacement for the well established CFD series of CoolMOST™. Besides higher breakdown-voltage of CFD2 with 650V, this new high voltage CoolMOST™ series with integrated body diode offers valuable improvements compared to the previous CFD series. The product portfolio provides all benefits of fast switching superjunction MOSFETs and additionally:

- Increased light load efficiency due to lower gate charge value
- Less energy gets stored in output capacitance, which is crucial for efficiency in high line or light load conditions  $E_{oss}$
- Limited voltage overshoot during hard commutation
  - Self limiting  $di/dt$  and  $dv/dt$  (softer commutation) results in reduced EMI appearance and higher reliability
- Low  $Q_{rr}$  at repetitive commutation on body diode & low  $Q_{oss}$  enable lower switching losses
- Reduced turn on and turn off delay times enable higher duty cycles and/or higher switching frequency
- Improved cost/performance compared to 600V CFD predecessor
- Technology availability also in SMD package

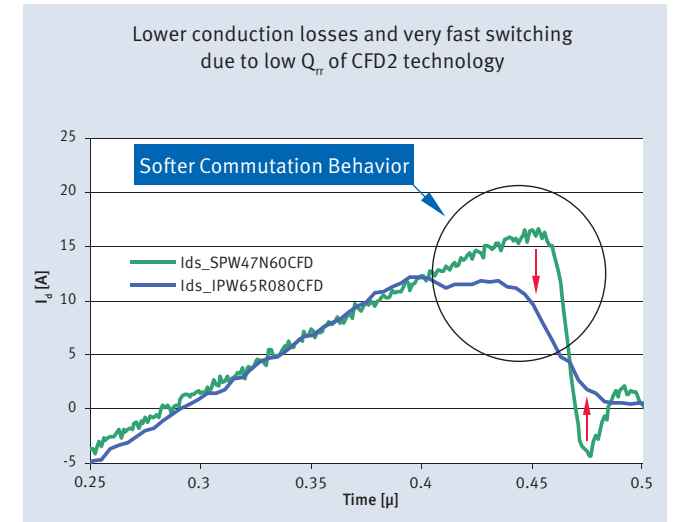
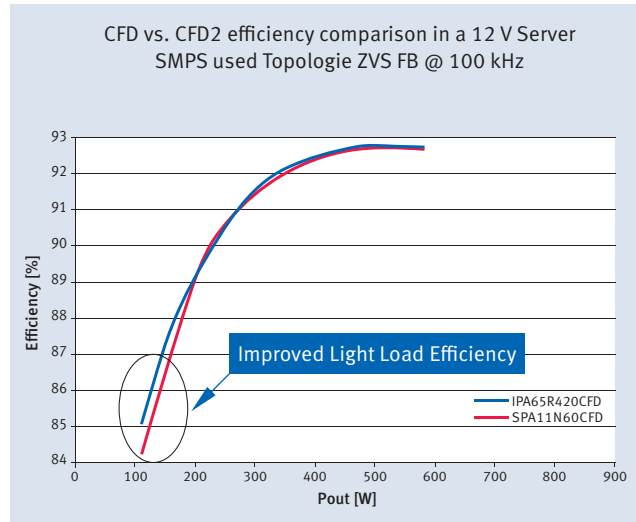
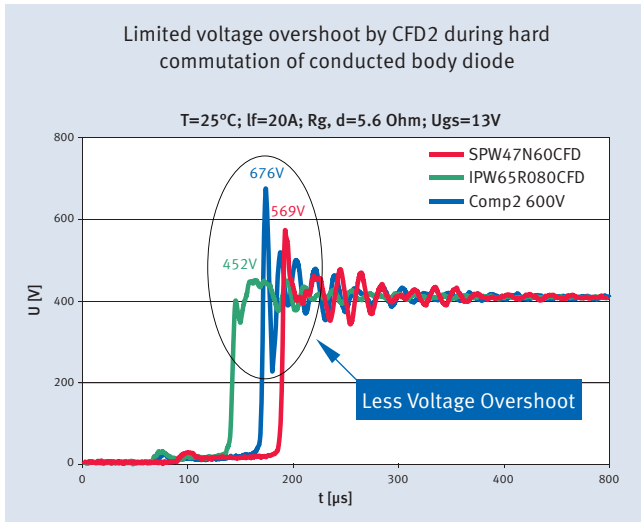
Furthermore easy implementation as well as outstanding product quality and reliability remain key benefits of the CoolMOST™ CFD2 series.

Specification	Symbol	SPW47N60CFD	IPW65R080CFD	Benefits
On-state resistance: maximum rating, 25 °C	$R_{DS(on)}$	83mΩ	80mΩ	Lower conduction losses
Total gate charge	$Q_g$	248nC	170nC	Improved light load efficiency
Breakdown voltage	$V_{DS}$	600V	650V	Higher overvoltage margin provides increased safety range & flexibility of the part to be used in more applications such as SMPS & Solar
Reverse recovery charge	$Q_{rr}$	2μC	1μC	Reduced switching losses
Energy stored in the output capacitance	$E_{oss} @ 400V$	20μJ	12μJ	Reduced switching losses
Reverse recovery time	$t_{rr}$	210ns	180ns	Faster recovery

## What is the difference between CFD2 & CFDA?

CoolMOST™ CFDA is based on CFD2 technology, so performance is comparable. CoolMOST™ CFD2 is addressing Consumer and Industrial Applications. The CFDA series is even qualified to Automotive standard AEC-Q101, and therefore perfectly suitable for design into Automotive applications.

# Feature comparison between CFD2, CFD and closest competition



- Limited voltage overshoot due to soft commutation behavior of CFD2 contributes to higher reliability
- Significantly less voltage overshoot of CFD2 compared to competition enables easier design in

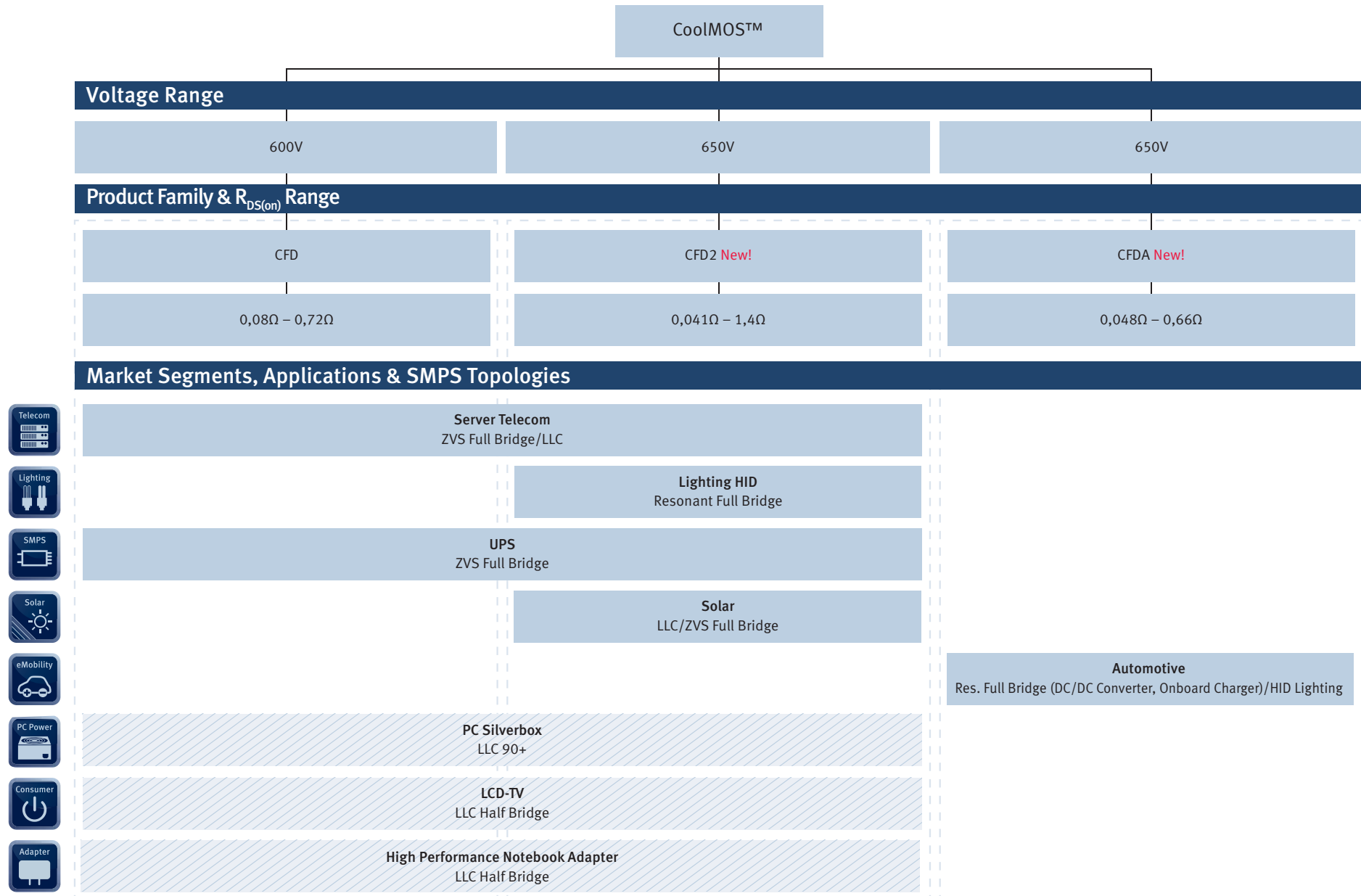
- Improved light load efficiency due to lower Q<sub>g</sub>
- New standards for servers require an efficiency measurement at 10% of maximum load rather than the previous 25% load. The above improved efficiency at low load enables customers to meet these new requirements

- Low Q<sub>rr</sub> of CFD2 technology enables lower conduction losses
- Softer commutation behavior reduces EMI as fast switching of current or voltage i.e. di/dt or dv/dt (main causes for EMI) have been decreased. This reduced EMI behavior saves customers' time and money in designing in the part

## CFD to CFD2 Cross Reference Table

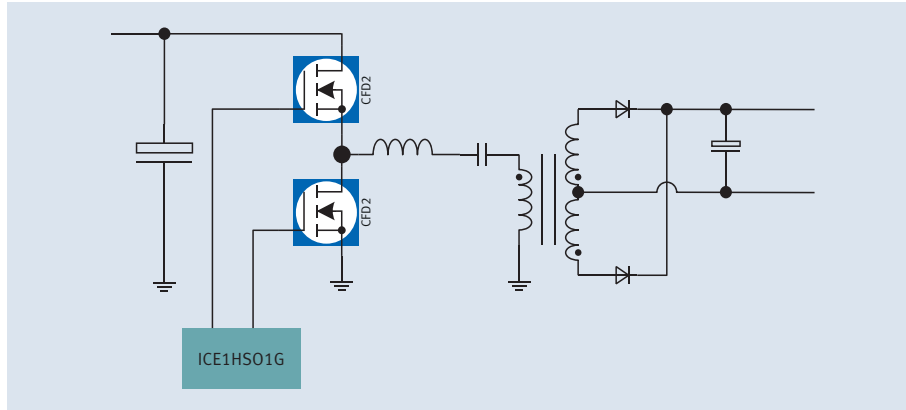
R <sub>DS(on)</sub>	I <sup>2</sup> PAK		TO-220		TO-220 FullPAK		TO-247	
	600V CoolMOS™ CFD	650V CoolMOS™ CFD2	600V CoolMOS™ CFD	650V CoolMOS™ CFD2	600V CoolMOS™ CFD	650V CoolMOS™ CFD2	600V CoolMOS™ CFD	650V CoolMOS™ CFD2
660		IP165R660CFD	SPP07N60CFD	IPP65R660CFD	SPA07N60CFD	IPA65R660CFD	SPW07N60CFD	IPW65R660CFD
420	SPI11N60CFD	IP165R420CFD	SPP11N60CFD	IPP65R420CFD	SPA11N60CFD	IPA65R420CFD	SPW11N60CFD	IPW65R420CFD
310	SPI15N60CFD	IP165R310CFD	SPP15N60CFD	IPP65R310CFD	SPA15N60CFD	IPA65R310CFD	SPW15N60CFD	IPW65R310CFD
190	SPI20N60CFD	IP165R190CFD	SPP20N60CFD	IPP65R190CFD	SPA20N60CFD	IPA65R190CFD	SPW20N60CFD	IPW65R190CFD
150		IP165R150CFD	SPP24N60CFD	IPP65R150CFD		IPA65R150CFD	SPW24N60CFD	IPW65R150CFD
110		IP165R110CFD		IPP65R110CFD		IPA65R110CFD	SPW35N60CFD	IPW65R110CFD
80							SPW47N60CFD	IPW65R080CFD
41								IPW65R041CFD

# CoolMOS™ Fast Body Diode Selection Guide

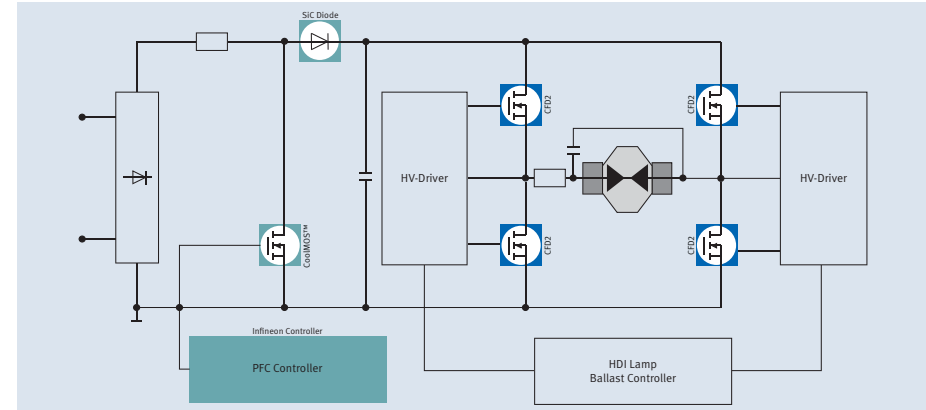


# Common CoolMOS™ Applications and Topologies

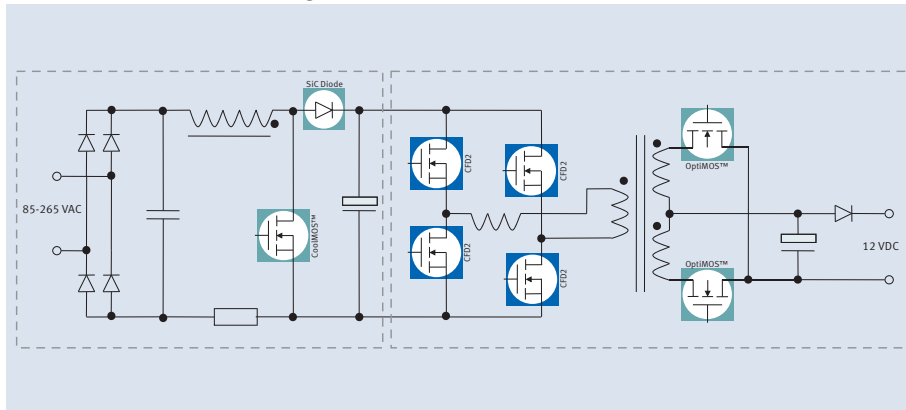
Resonant LLC Half-Bridge



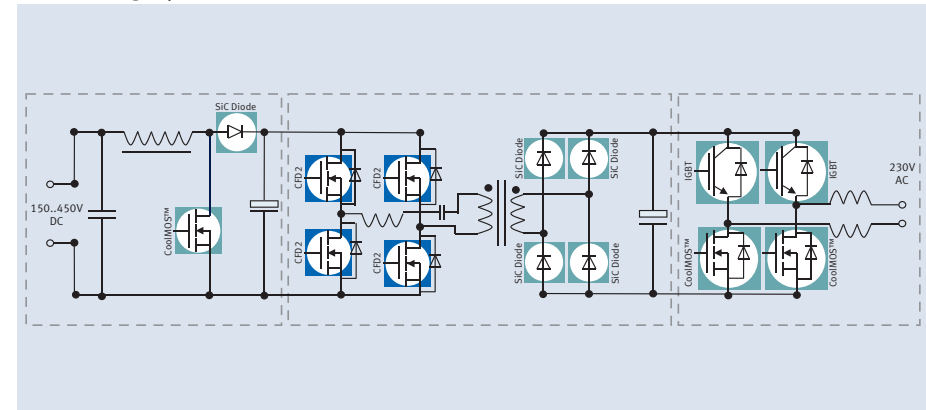
HID Lighting



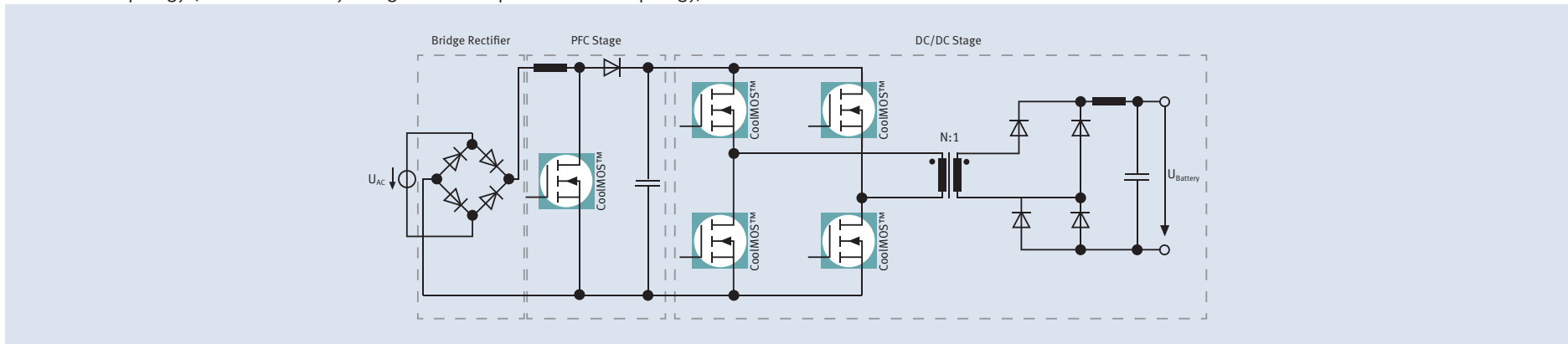
Phase Shift ZVS (ZVS Fullbridge)



Solar – Single phase solution, isolated



Automotive Topology (On-board battery charger with ZVS phase shifted topology)



# Available CoolMOS™ Fast Body Diode Portfolio

## Industrial product portfolio

CoolMOS™ CFD 600V									
$R_{DS(on)}$ [mΩ]	ThinPAK 8 x 8	TO-251 IPAK	TO-251 IPAK SL short leads	TO-252 DPAK	TO-262 I <sup>2</sup> PAK Halogen-Free	TO-263 D <sup>2</sup> Pak Halogen-Free	TO-220 Halogen-Free	TO-220 FullIPAK Halogen-Free	TO-247
700							SPP07N60CFD	SPA07N60CFD	SPW07N60CFD
440					SPI11N60CFD		SPP11N60CFD	SPA11N60CFD	SPW11N60CFD
330					SPI15N60CFD		SPP15N60CFD	SPA15N60CFD	SPW15N60CFD
220					SPI20N60CFD		SPP20N60CFD	SPA20N60CFD	SPW20N60CFD
185							SPP24N60CFD		SPW24N60CFD
115									SPW35N60CFD
80									SPW47N60CFD

CoolMOS™ CFD2 650V <b>New!</b>									
1400				IPD65R1K4CFD <sup>1)</sup>					
950				IPD65R950CFD <sup>1)</sup>					
660	IPL65R660CFD <sup>3)</sup>			IPD65R660CFD	IPI65R660CFD	IPB65R660CFD	IPP65R660CFD	IPA65R660CFD	IPW65R660CFD
420	IPL65R420CFD <sup>3)</sup>			IPD65R420CFD	IPI65R420CFD	IPB65R420CFD	IPP65R420CFD	IPA65R420CFD	IPW65R420CFD
310	IPL65R310CFD <sup>3)</sup>				IPI65R310CFD	IPB65R310CFD	IPP65R310CFD	IPA65R310CFD	IPW65R310CFD
190	IPL65R190CFD <sup>3)</sup>				IPI65R190CFD	IPB65R190CFD	IPP65R190CFD	IPA65R190CFD	IPW65R190CFD
150					IPI65R150CFD	IPB65R150CFD	IPP65R150CFD	IPA65R150CFD	IPW65R150CFD
110					IPI65R110CFD	IPB65R110CFD	IPP65R110CFD	IPA65R110CFD	IPW65R110CFD
80									IPW65R080CFD
41									IPW65R041CFD

## Automotive product portfolio

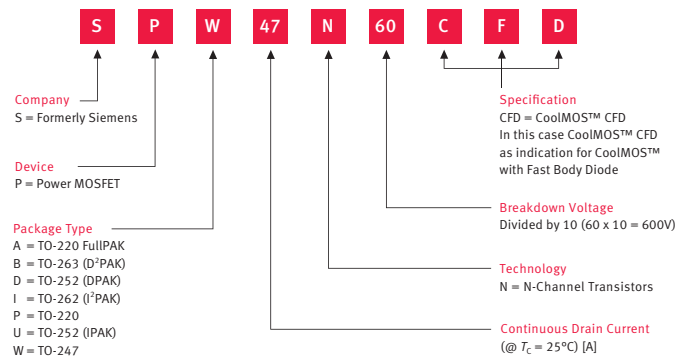
CoolMOS™ CFDA 650V <b>New!</b>									
660				IPD65R660CFDA <sup>2)</sup>		IPB65R660CFDA <sup>2)</sup>	IPP65R660CFDA <sup>2)</sup>		
420				IPD65R420CFDA <sup>2)</sup>					
310						IPB65R310CFDA <sup>2)</sup>	IPP65R310CFDA <sup>2)</sup>		
190						IPB65R190CFDA <sup>2)</sup>	IPP65R190CFDA <sup>2)</sup>		IPW65R190CFDA <sup>2)</sup>
150						IPB65R150CFDA <sup>2)</sup>	IPP65R150CFDA <sup>2)</sup>		IPW65R150CFDA <sup>2)</sup>
110						IPB65R110CFDA <sup>2)</sup>	IPP65R110CFDA <sup>2)</sup>		IPW65R110CFDA <sup>2)</sup>
80									IPW65R080CFDA <sup>2)</sup>
48									IPW65R048CFDA <sup>2)</sup>

<sup>1)</sup> Product release Q1 2012

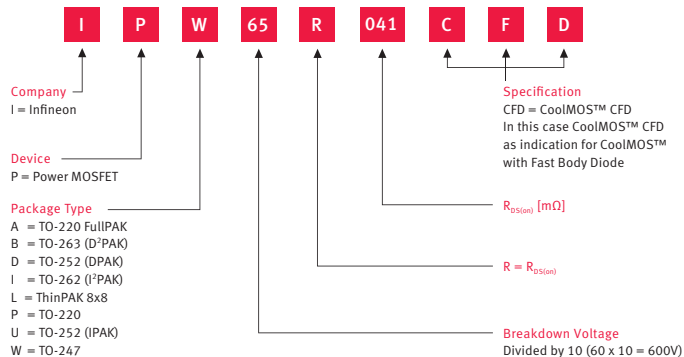
<sup>2)</sup> Product release Q2 2012

<sup>3)</sup> Product release 2<sup>nd</sup> half of 2012

### Power MOSFETs (naming system till 2005)



### Power MOSFETs (naming system from 2005 onwards)



CFD2 and CFDA are recommended for new designs.

For further information please go on [www.infineon.com/coolmos](http://www.infineon.com/coolmos)