

Infineon IGBTs

Market Leadership Through Innovation

Zhou Ryan

Power Management & Supply Discretes



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Infineon IGBTs at a Glance

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New High Speed 3 IGBT Family

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New High Speed 3 IGBT Family – 600V

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New High Speed 3 IGBT Family – 1200V

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New High Speed 3 IGBT Family - Summary

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Infineon Inside

Infineon Discrete IGBTs did you know?



Infineon is the #1 world wide supplier of discrete IGBTs ...
... where 1 in every 4 discrete IGBT sold comes from Infineon*

*IMS-The World Market for Power Semiconductor Discretets & Modules 2009

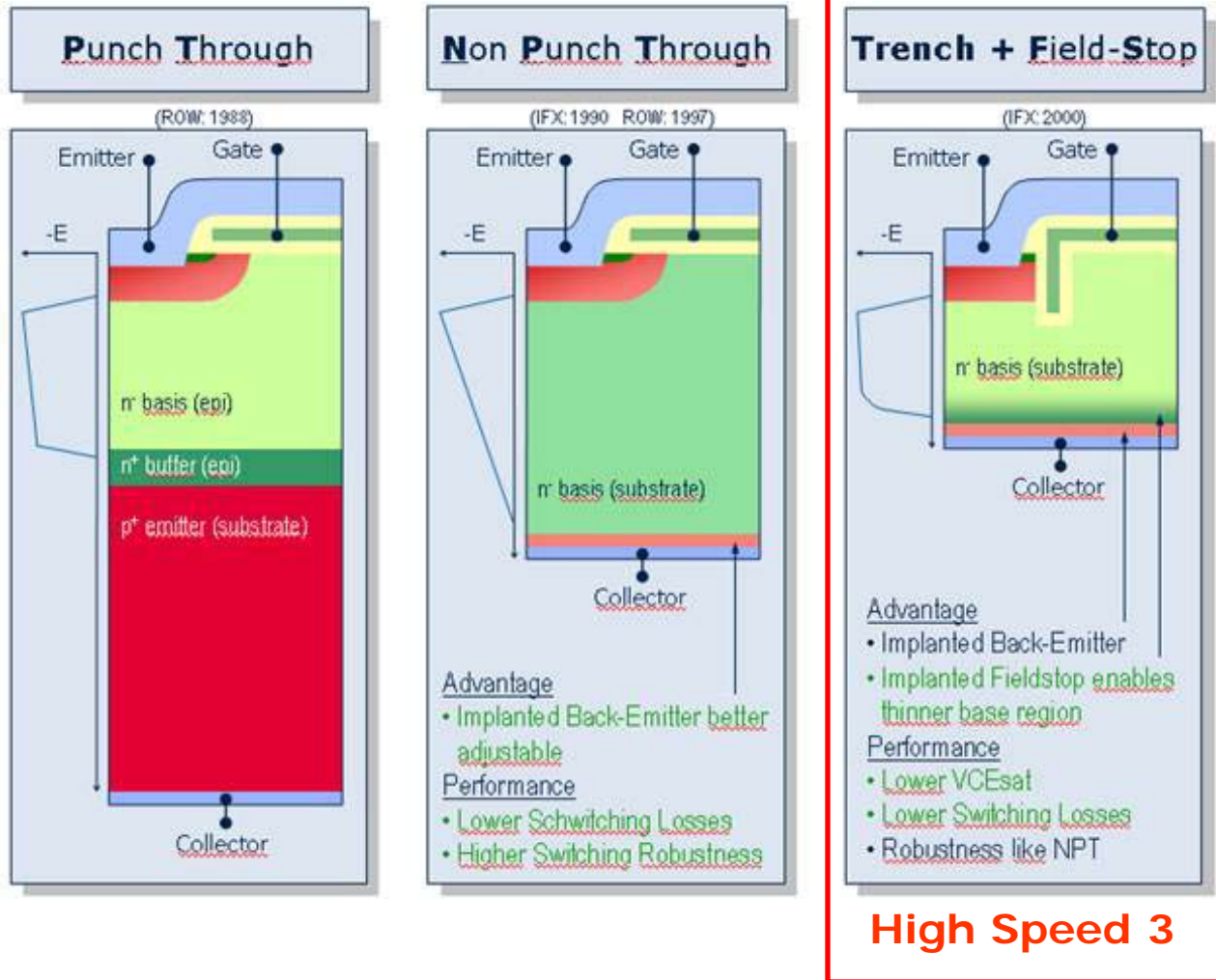
How is this possible?

- ✓ High efficiency (cooler packages)
Low switching & conduction losses
- ✓ Excellent EMI behaviour
- ✓ Highest quality standards
- ✓ Logistic Management



IGBT Technology selection

- TrenchStop™ in thin wafer technology with carrier profile optimized for fast switching



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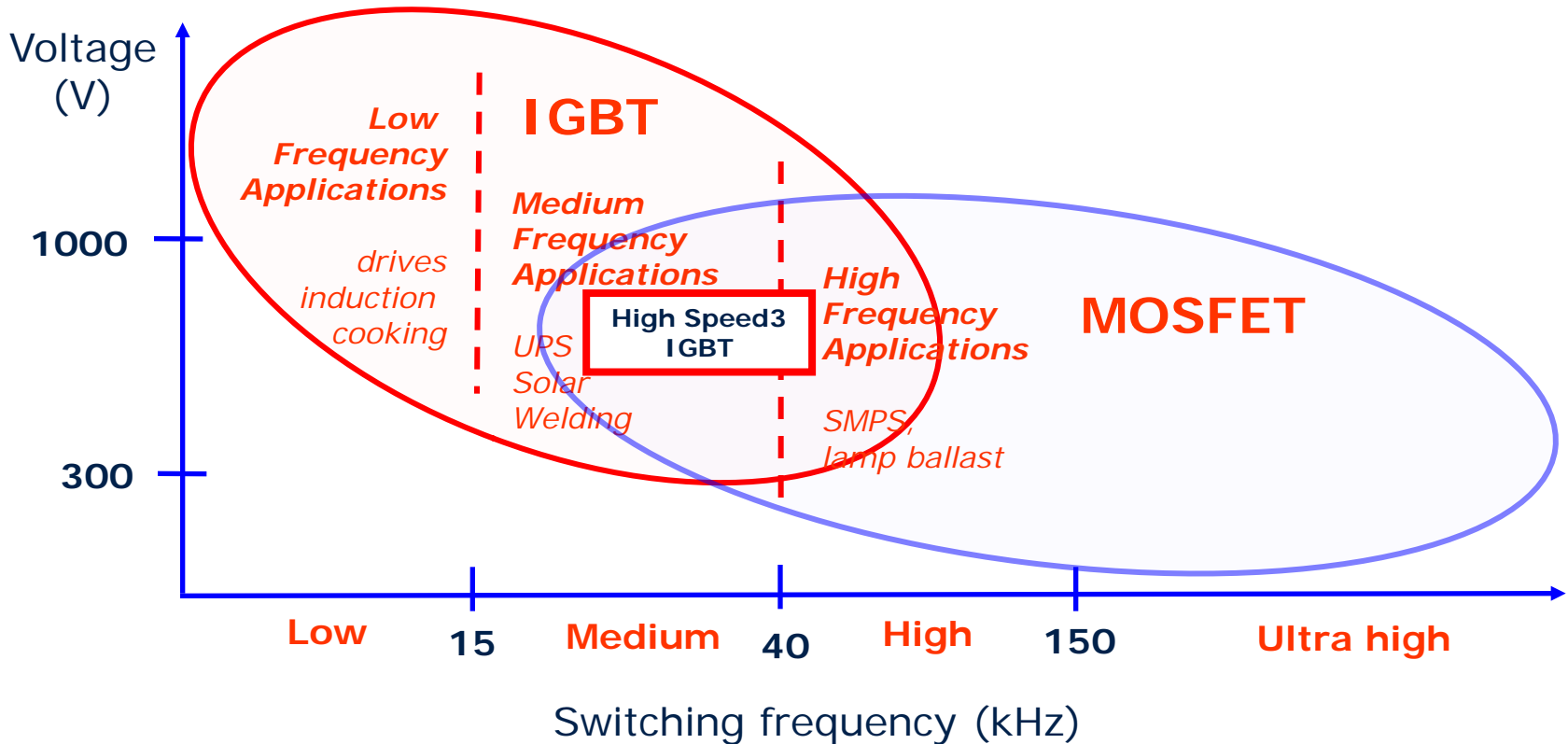
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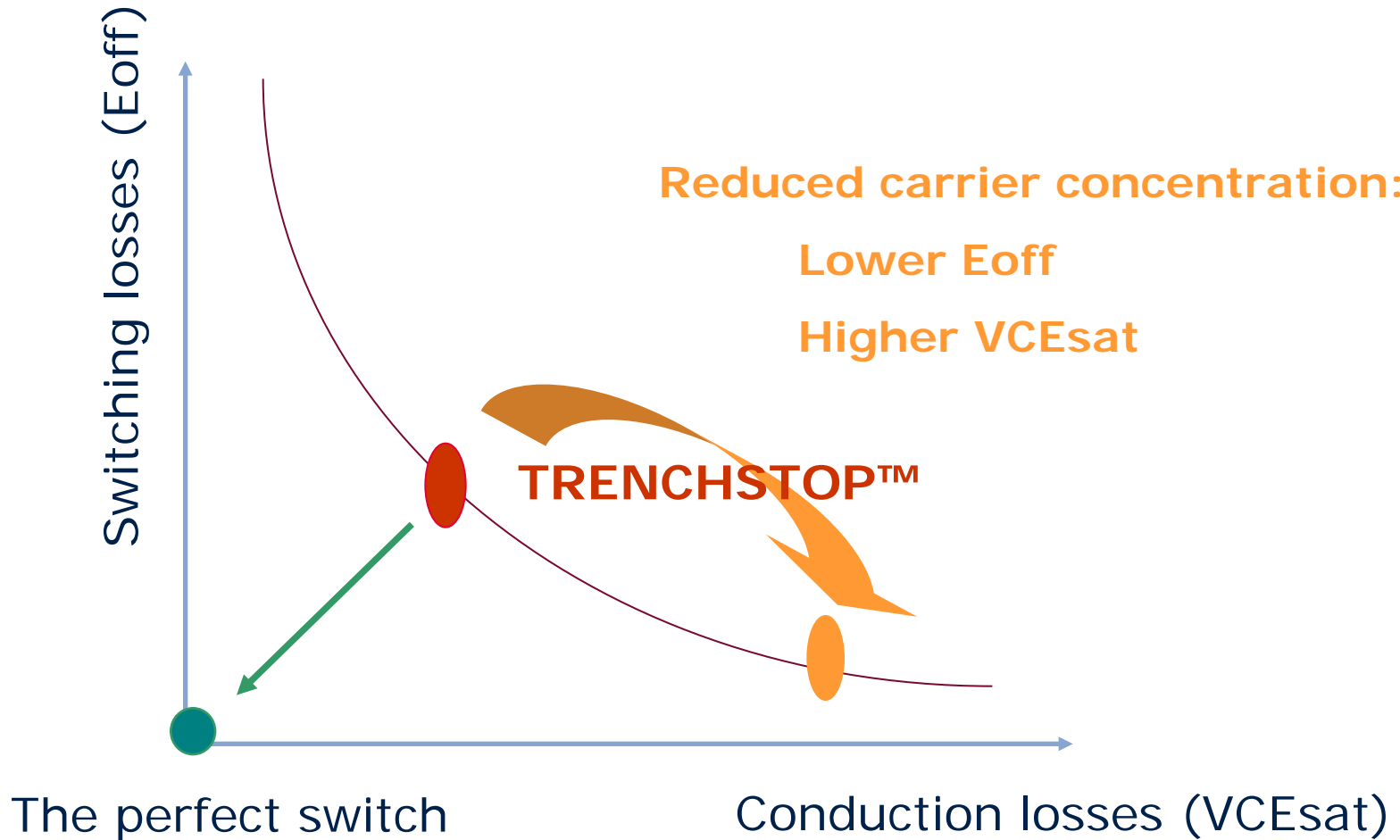
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Motivation for High Speed 3 IGBT



- High Speed IGBT was developed to bridge the gap between IGBT and MOSFETs in mid-to-high frequency hard-switching applications

IGBT Performance Tuning for High Speed



There is trade-off - but we haven't given up!

New Optimisation of the Infineon TRENCHSTOP™ Technology for High Speed Applications



Low switching & conduction lossesPerfect optimisation

- ✓ New family is designed specifically for applications switching at frequencies below 100 kHz
- ✓ Low switching losses for high efficiency
- ✓ Excellent $V_{ce(sat)}$ behaviour thanks to the famous Infineon TRENCHSTOP™ technology
- ✓ Fast soft switching behaviour meaning excellent EMI behaviour
- ✓ Optimised diode for target applications, meaning further improvement in switching losses
- ✓ Low gate resistor selection possible (down to 5Ω) whilst maintaining excellent switching behaviour
- ✓ Proven cosmic radiation robustness



Target Applications

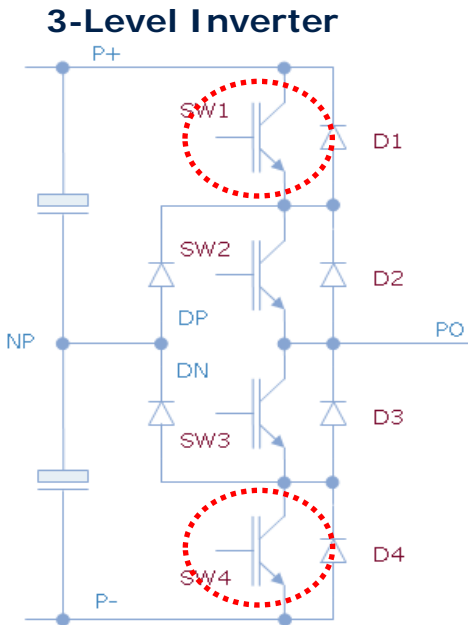
High Speed 3 IGBT for hard switching topologies

UPS, Solar, Welding:

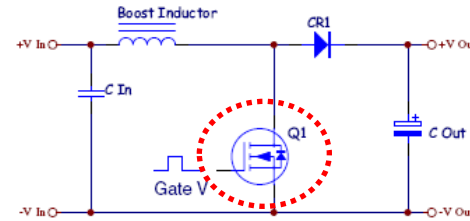
- Frequency range 16kHz and above
- Power factor close to 1
- Low EMI, high efficiency
- Hard commutation

SMPS

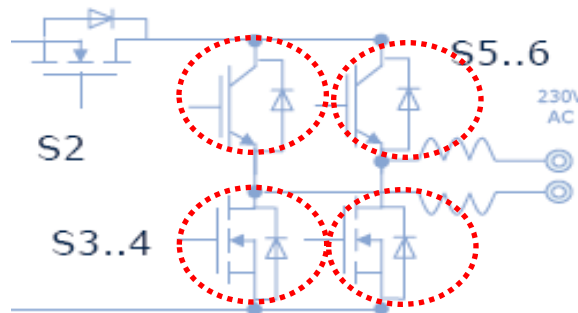
- Frequency range < 100kHz
- High dV/dt
- Hard commutation



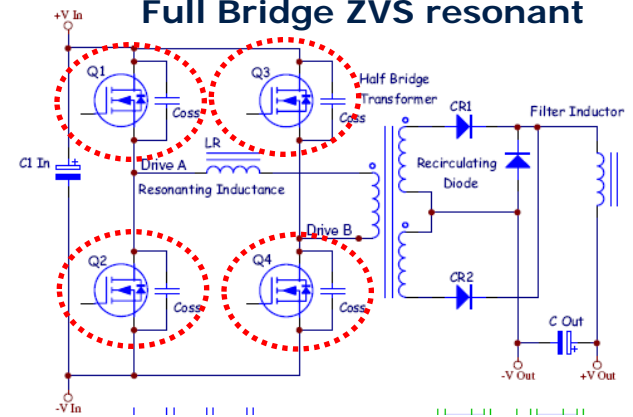
Boost PFC



H4 Inverter



Full Bridge ZVS resonant



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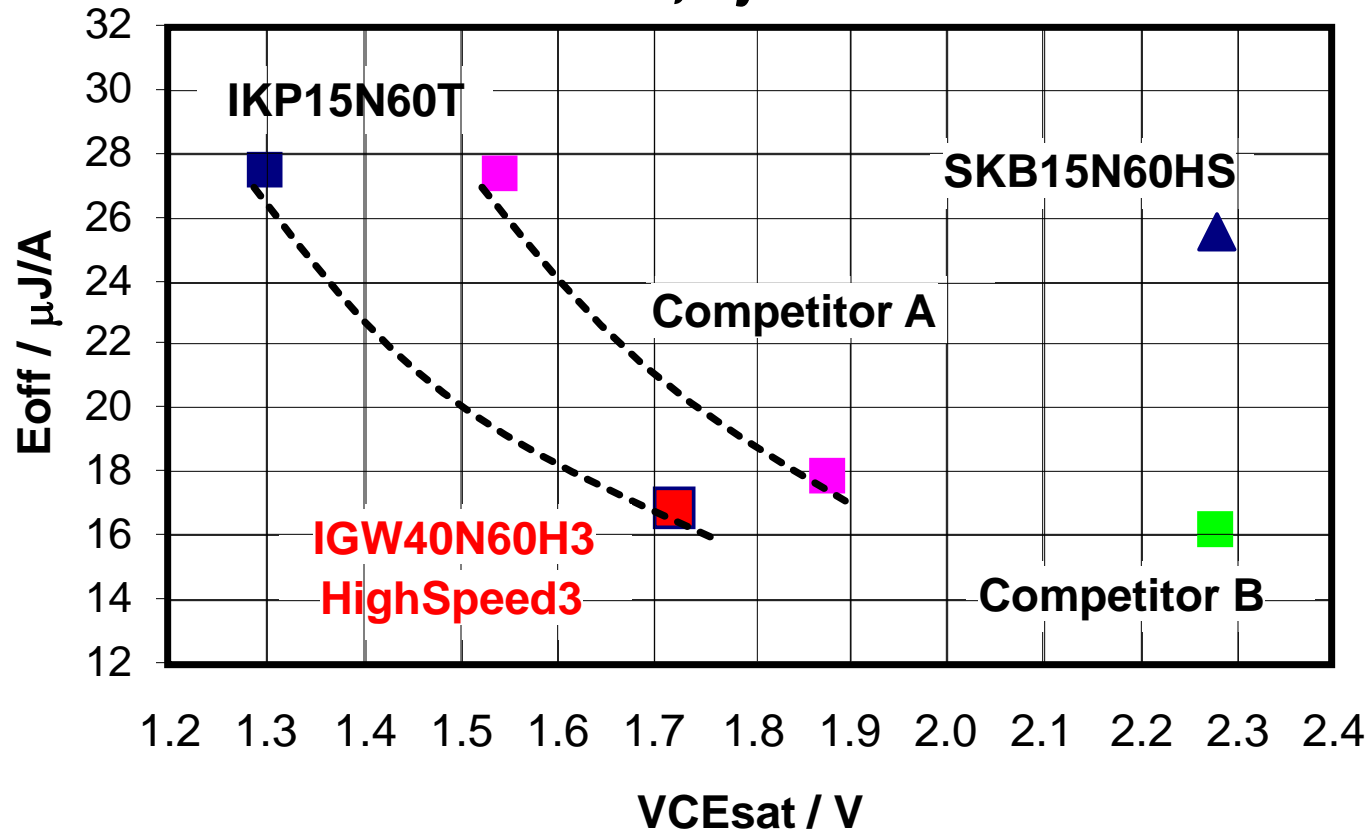
New High Speed 3 IGBT Family - Summary

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Infineon Inside

High Speed IGBT Competitor Landscape

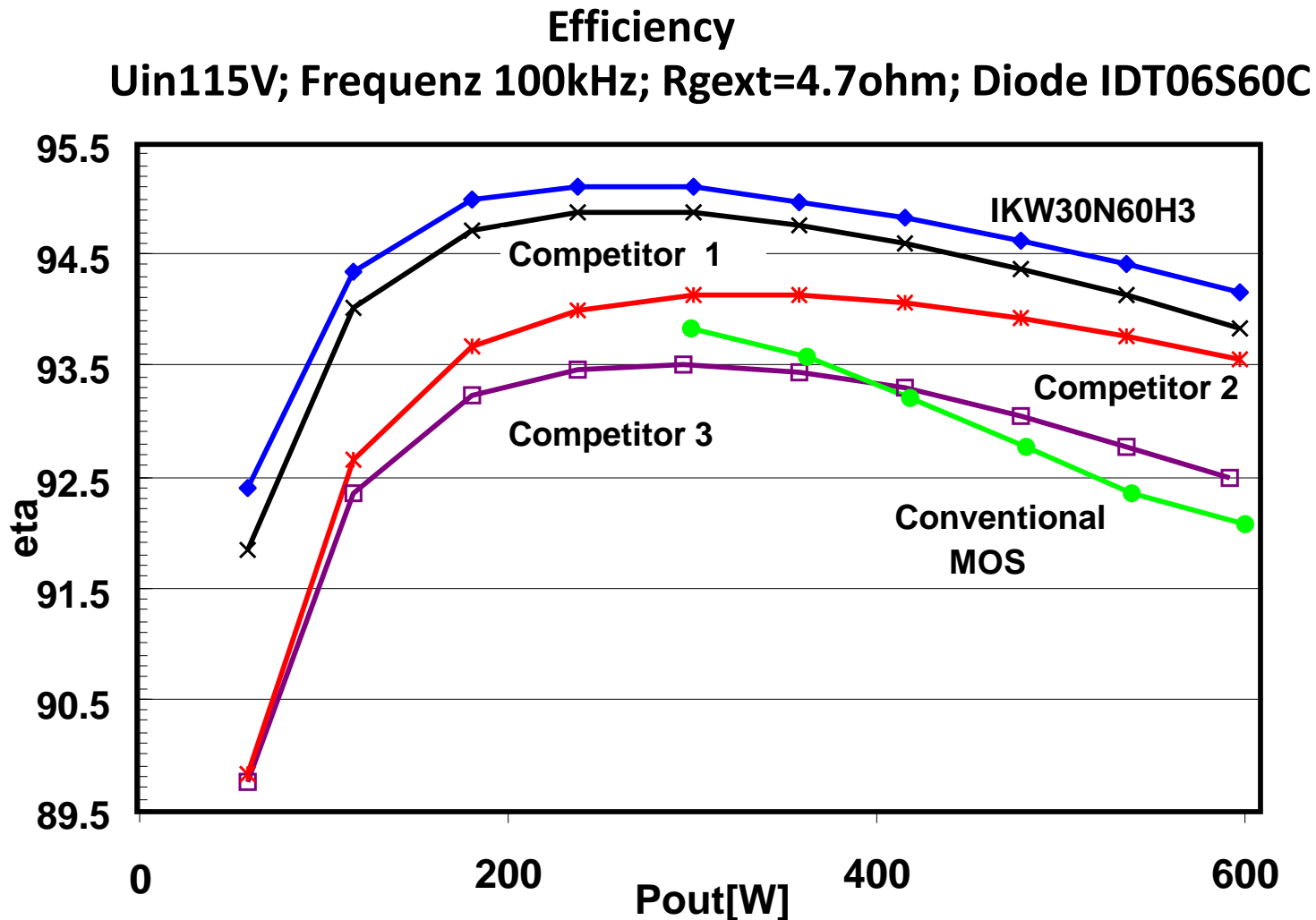
Trade-off diagram
 $I_c = I_n/2, T_j = 150^\circ\text{C}$



High Speed means High Speed

Application test – PFC at 100kHz

Best in Class High Speed Performance



HighSpeed3 IGBT provides ~ 1% better efficiency than conventional MOSFETs at 100 kHz!!

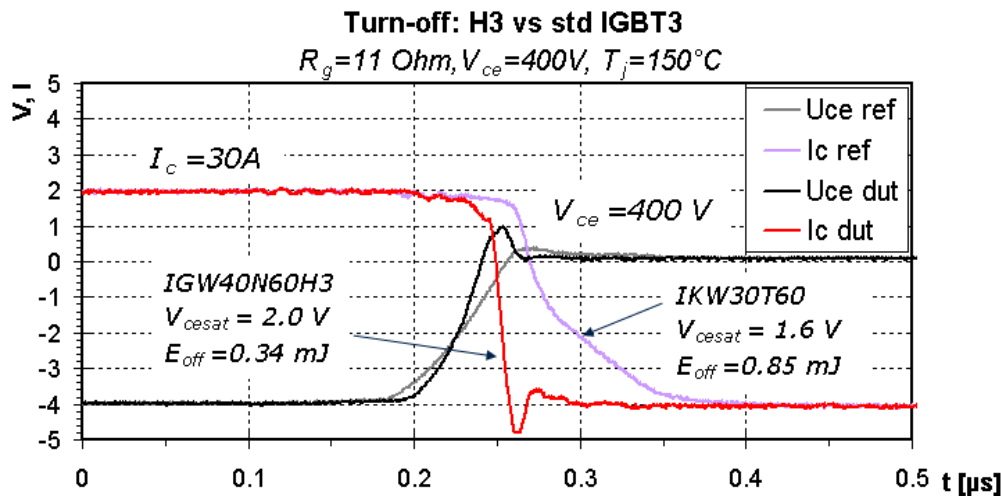
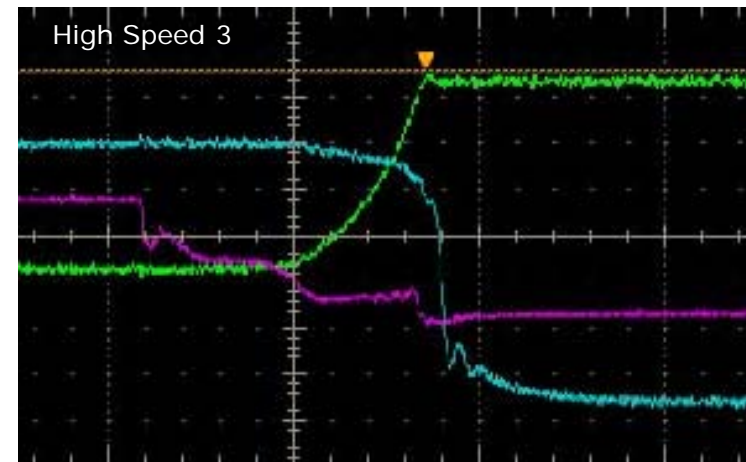
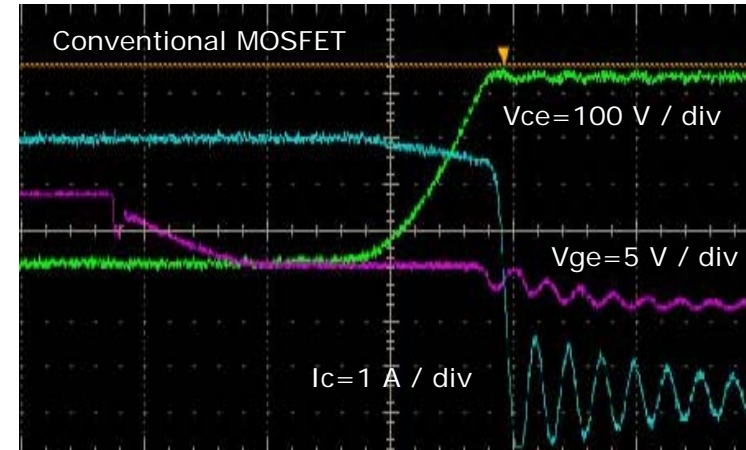
PFC Application Test at 100kHz

The EMI Advantage



EMI – What EMI?

- Smooth switching waveforms in application
- No Current oscillations
- No overvoltage
- Gate resistor selection
- Go low for high performance



r: IKW30T60_#

Vce 100V/div, NP -4

Ic 5A/div, NP -4

Vgs 10V/div, NP 0

r: IGW40T6

Vce 100V/div, NP -4

Ic 5A/div, NP -4

Vgs 10V/div, NP 0

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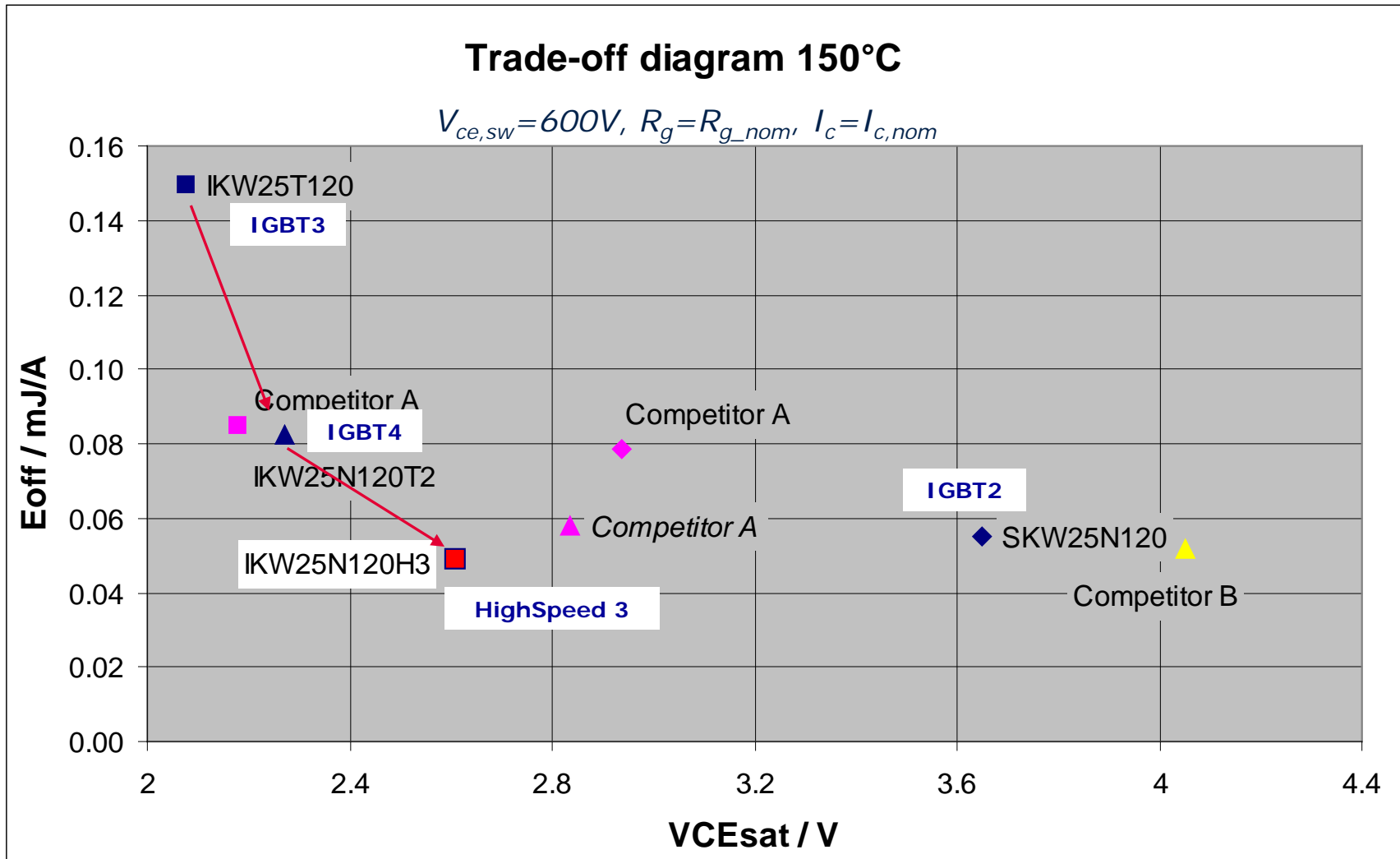
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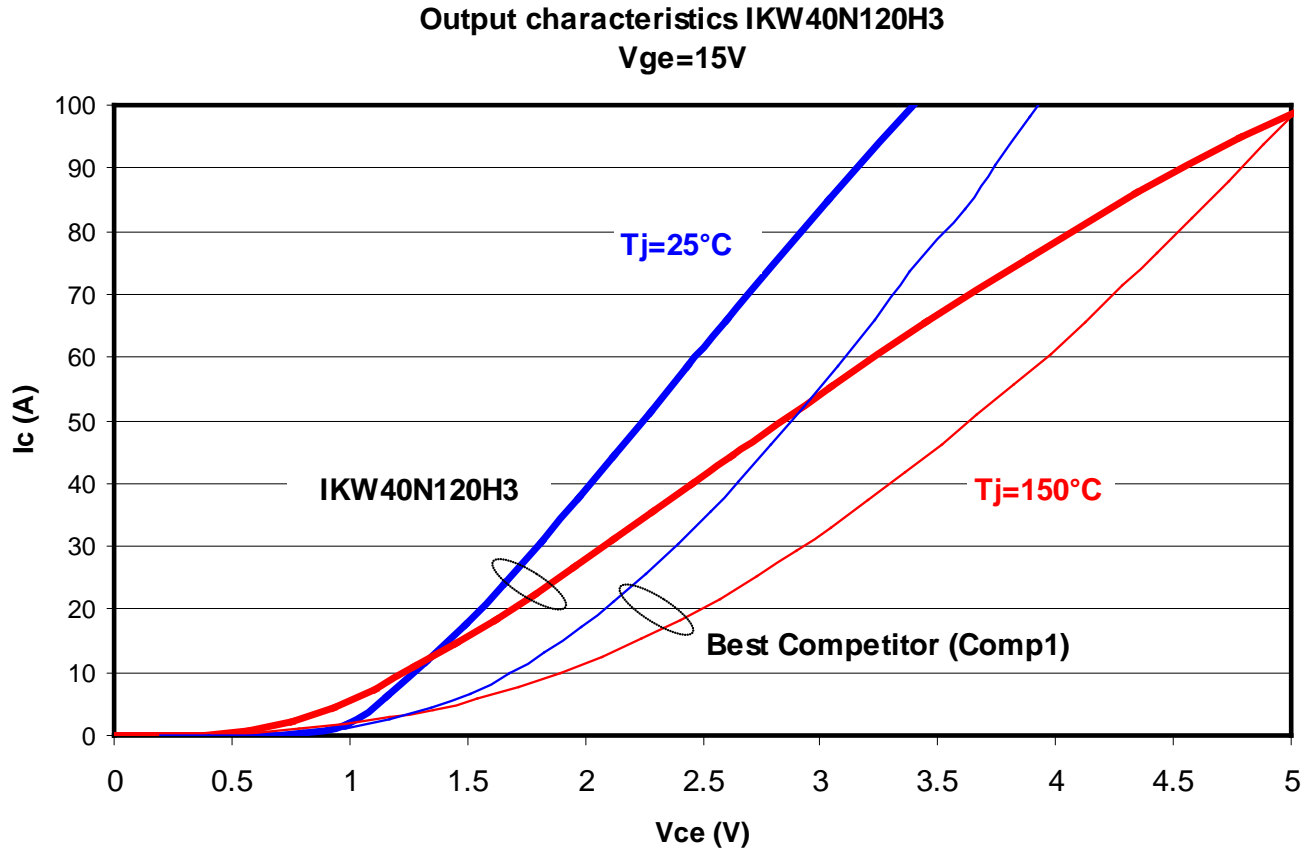
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Infineon Inside

Best in Class Performance Competitor's Landscape



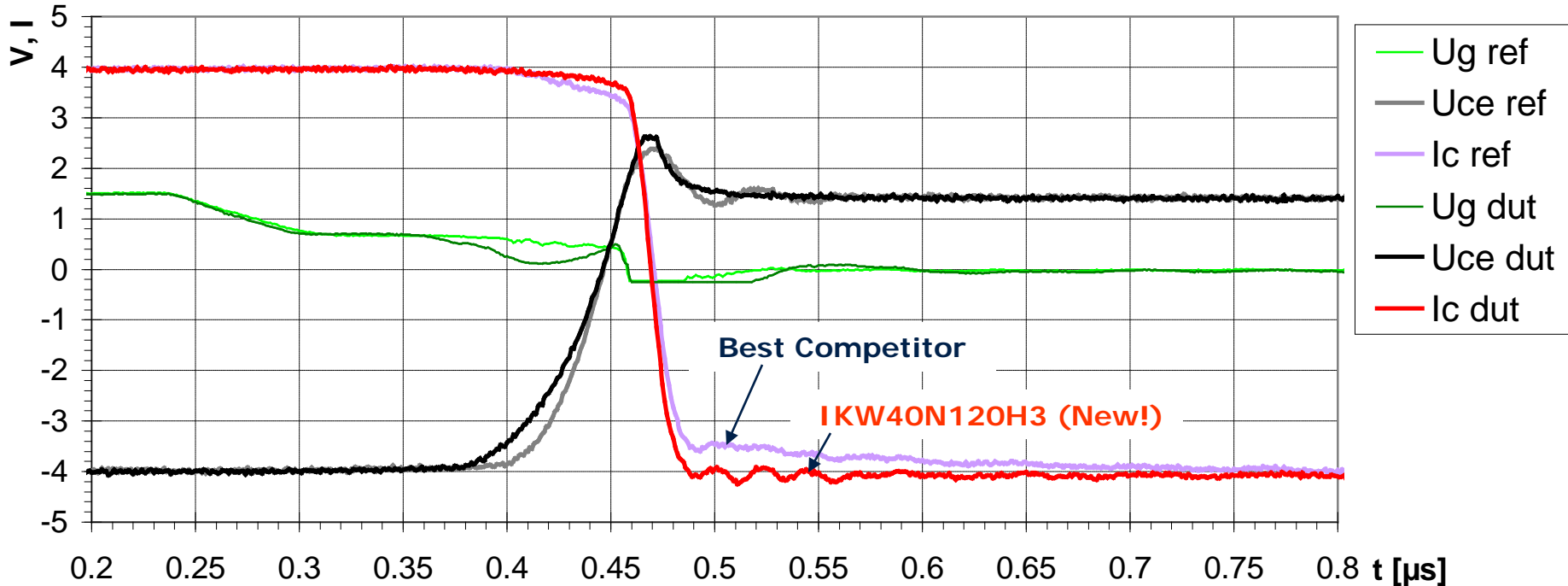
Output characteristics



- Low switching losses without penalizing V_{cesat}

Example of Turn-off Waveforms

$I_c = 40A$, $V_{dc} = 800V$, $R_{goff} = 5 \text{ Ohm}$, $T_j = 25C$



Vce 150V/div, NP -4

Ic 5A/div, NP -4

Vgs 10V/div, NP 0

Vce [V]: 800 Rg [Ohm]: 5.2

Ice [A]: 39.98 Vge [V]: 15

T [°C]: 25

tdoff [ns]: 202

tf [ns]: 19

tf Tang. [ns]: 17.94

dUce/dt [V/ns]: 22.27

dlc/dt [A/µs]: -1322

Eoff [mJ]: 1.39

IKW40N120

Vce 150V/div, NP -4

Ic 5A/div, NP -4

Vgs 10V/div, NP 0

Vce [V]: 800 Rg [Ohm]: 5.2

Ice [A]: 39.98 Vge [V]: 15

T [°C]: 25

tdoff [ns]: 202

tf [ns]: 19

tf Tang. [ns]: 17.94

dUce/dt [V/ns]: 22.27

dlc/dt [A/µs]: -1322

Eoff [mJ]: 1.39

Infineon's High Speed 3 IGBT Portfolio

600V and 1200V Product Family



		600V			1200V
		TO-263	TO-220	TO-247	TO-247
Continuous collector current at $T_c = 100^\circ\text{C}$					
Single IGBT	15A				IGP15N120H3 ✓
	20A	IGB20N60H3 ✓	IGP20N60H3 ✓	IGW20N60H3 ✓	
	25A				IGP25N120H3 ✓
	30A	IGB30N60H3 ✓	IGP30N60H3 ✓	IGW30N60H3 ✓	
	40A			IGW40N60H3 ✓	IGP40N120H3 ✓
	50A	* Engineering samples October 2010			IGW50N60H3 ✓
DuoPack™	15A				IKW15N120H3 ✓
	20A	IKB20N60H3 ✓	IKP20N60H3 ✓	IKW20N60H3 ✓	
	25A				IKW25N120H3 ✓
	30A	IKB30N60H3 ✓	IKP20N60H3 ✓	IKW30N60H3 ✓	
	40A			IKW40N60H3 ✓	IKW40N120H3 ✓
	50A			IKW50N60H3 ✓	
	75A			IKW60N60H3*	
75A			IKW75N60H3*		

✓ Devices are fully released



Infineon IGBTs at a Glance



New High Speed 3 IGBT Family



New High Speed 3 IGBT Family – 600V



New High Speed 3 IGBT Family – 1200V



New High Speed 3 IGBT Family - Summary



Infineon Inside

High Speed 3 Summary

- Infineon's new High Speed3 IGBT family has been developed for operation up to 100kHz

- Target applications:

- PFC, Solar, welding and UPS ...

- All high frequency – hard switching applications

- Offering

- ~ 1% efficiency improvement over all load conditions

- EMI and RF filtering requirements significantly reduced

- Temperature stable behaviour

- Smaller die sizes → smaller packages

- Excellent price / performance behaviour

- Optimised diode



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Infineon Inside!

Discrete IGBTs Applications



	RC-Drives 600V	HighSpeed3 600V 1200V	HighSpeed2 1200V	TrenchStop 600V 900V 1000V 1200V	TrenchStop2 1200V	Rev. Cond. (Soft) 1200V 600V
<input type="checkbox"/> Washing Machines	✓			✓		
<input type="checkbox"/> Air Conditioning	✓			✓		
<input type="checkbox"/> Induction Heating		✓		✓	✓	✓
<input type="checkbox"/> PFC		✓		✓		
<input type="checkbox"/> Servo Drives	✓				✓	
<input type="checkbox"/> UPS / Welding		✓			✓	
<input type="checkbox"/> Solar		✓		✓	✓	✓
<input type="checkbox"/> Automotive	Technologies qualified on demand					
<input type="checkbox"/> HV AC	✓			✓		
<input type="checkbox"/> Aux Power Supply		✓	✓			

✓ Best fit



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