



Induction heating and motor control in small home appliances – Cooking, cooling, drying

July, 2020



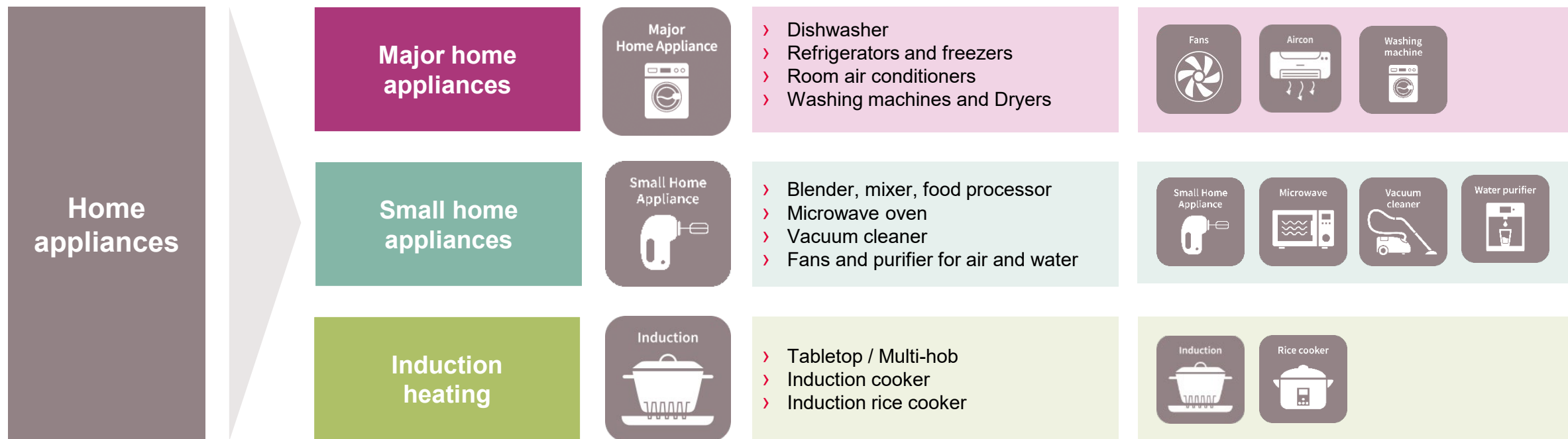
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- 1 What's driving the small home appliance market?
- 2 Induction heating solutions for cooking appliances
- 3 Low power drive solutions for small home appliances
- 4 Mixer and blenders
- 5 Water purifiers
- 6 Ceiling fan
- 7 Summary

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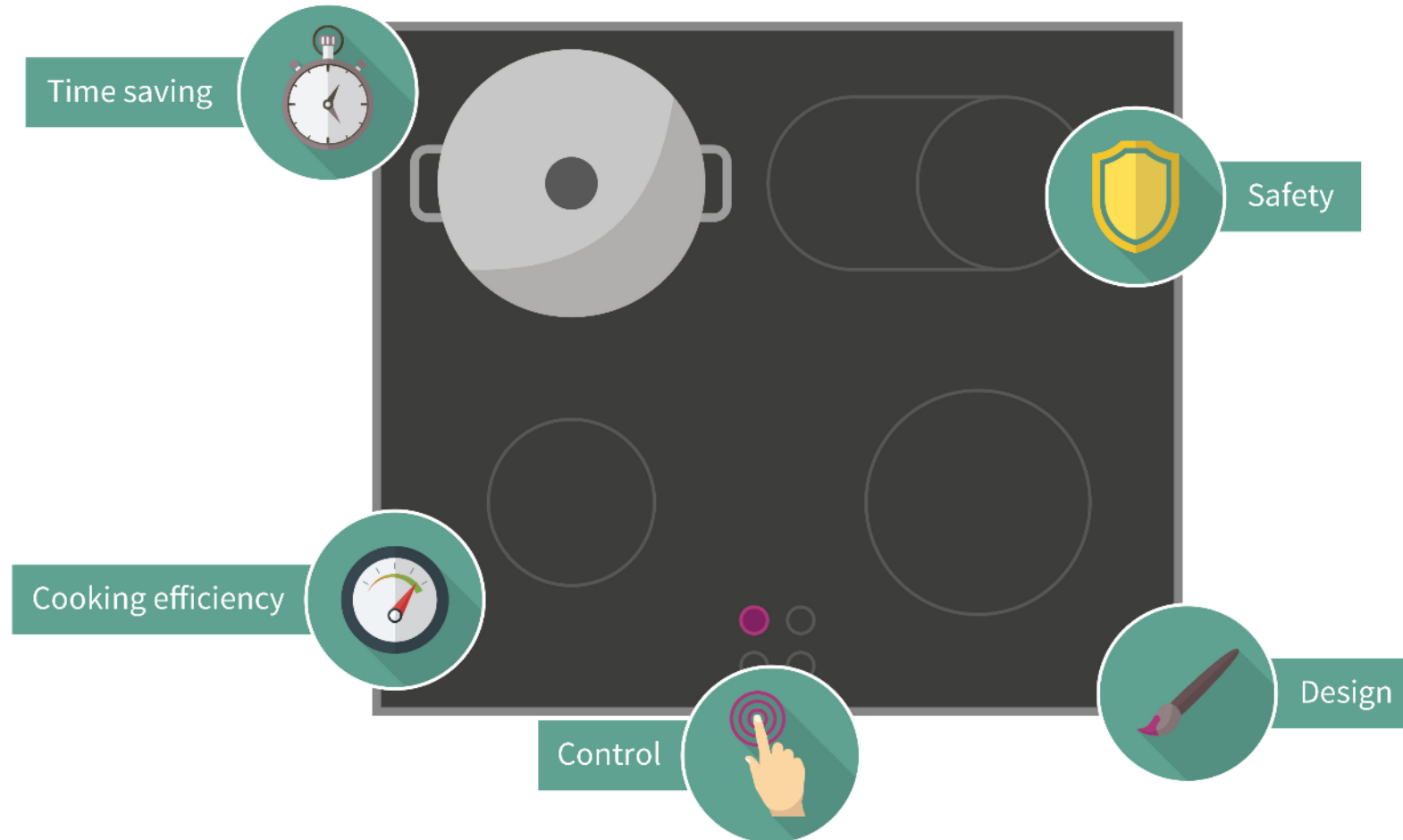
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Overview of home appliances



Efficiency, control, and connectivity: Induction heating is more and more a standard in cooking appliances

Key advantages of induction cooking



Different appliances have different requirements: Inverterization of drives helps to fulfill all of them



Brushless DC (BLDC) blender

- › Longer lifetime
- › Less noisy
- › More Efficient



BLDC hair dryer

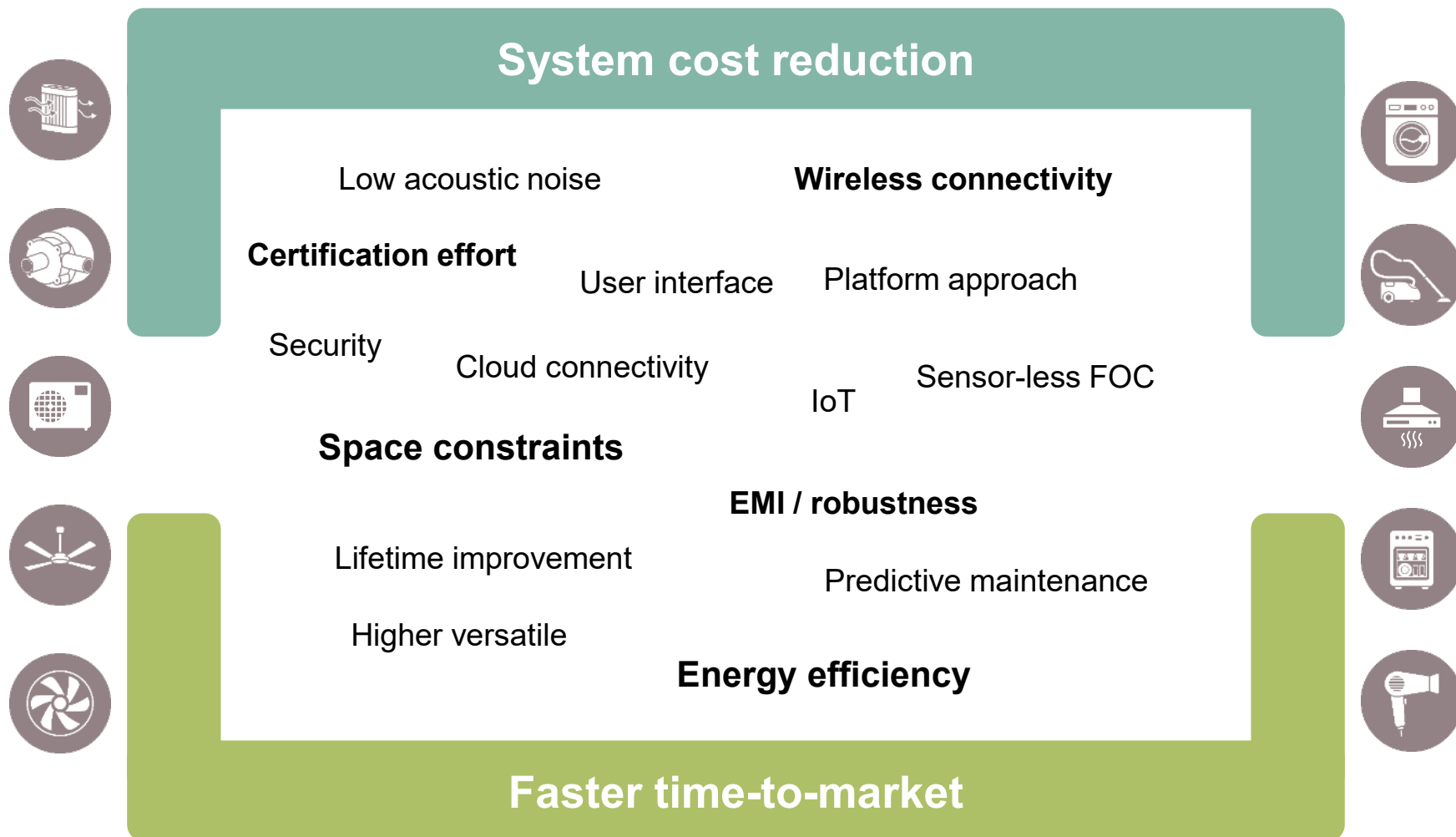
- › Longer lifetime
- › More powerful airflow
- › Smart heat control



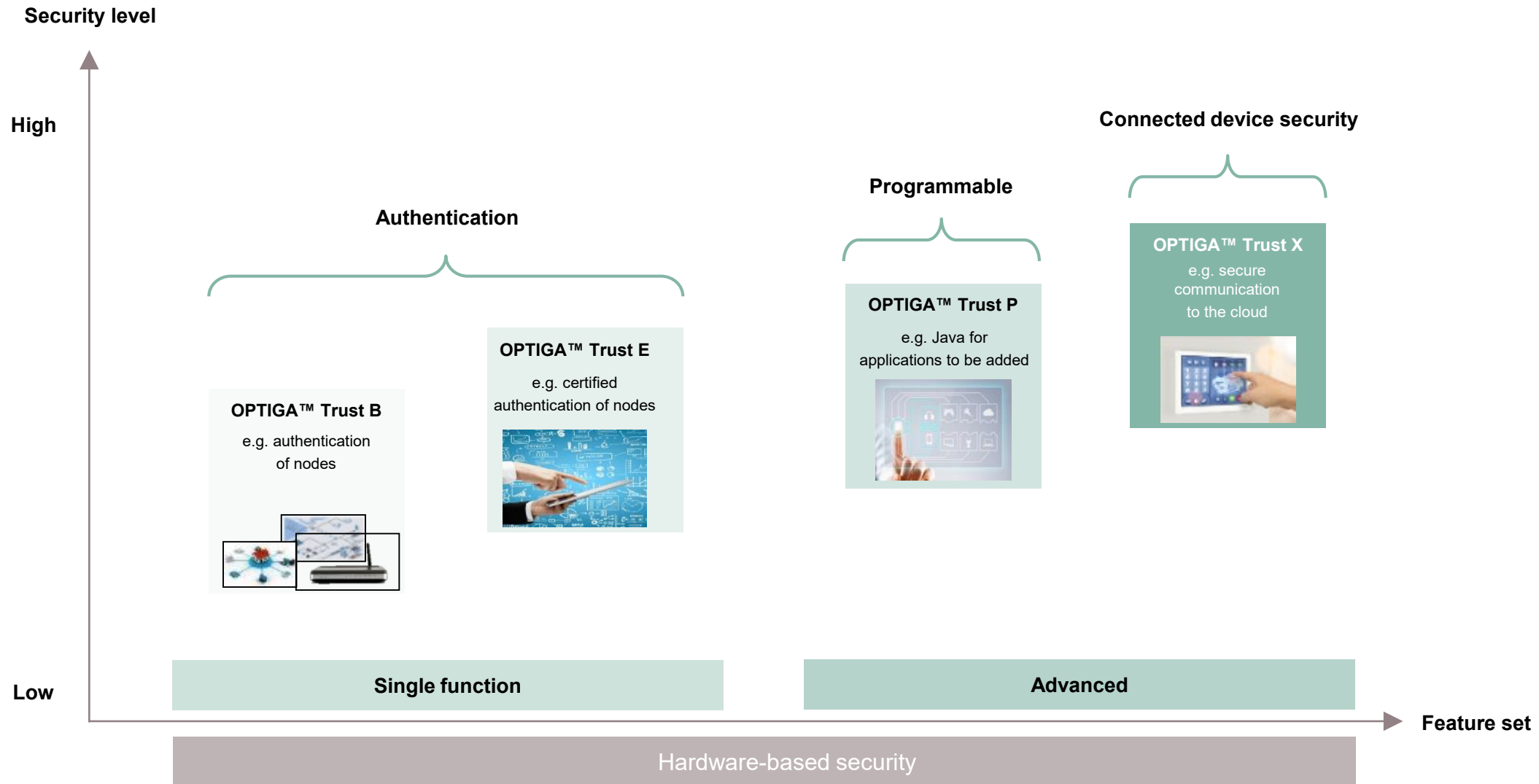
Water purifier

- › No water tank; no bacterial propagation
- › Slim design
- › Cold water by inverterized compressor
- › Hot water by induction heating

Infineon leads incorporation of market trends in home appliances



The right security for connected home appliances: OPTIGA™ product portfolio



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Induction cooking – Resonant switching applications



Application spaces



Advanced features

Reverse conducting IGBTs include monolithically integrated diodes

- › **650 V RC-H5** – lowest $V_{CE(sat)}$ as well as lower E_{off} for best efficiency and thermal performance
- › **1200V, 1350V & 1600V RC-H5** – Best performance, especially at higher switching frequencies
- › **1200V RC-E** – Cost effective, optimized for price vs. performance
- › **IPD Protect** – Best performance in class IGBT – 20A 1350V in RC-H5 technology co-packed with driver with protective functions

The evolution of the induction cooker

Low price & short service life

Basic cooking functionality

Pushbuttons – not reliable or waterproof

Thick body designed for airflow and cost

Energy efficiency labeling

Full featured – precision heat control, multiple settings

Wi-Fi ready and additional “smart” features

Safety features, long service life

Sleek, thin design for best appearance, cleaning, waterproof

Induction cooking – Application landscape



Half-bridge topology

Most common applications:

- › Multi-Hob induction stoves
- › Inverterized microwave ovens






Single ended topology

Most common applications:

- › Table top induction cooker
- › Induction rice cooker
- › Inverterized microwave ovens

Extended RC IGBT portfolio for induction cooking appliances

I _c nom [A]	Features	Price	Performance				Protection	Appliances
	Topology	Single ended	Half bridge	Single ended			Single ended	  
	Family	E1	R5	R5	R5	R5	IPD Protect	
	Voltage	1200 V	650 V	1200 V	1350 V	1600 V	1350 V	
15		IHW15N120E1						
20			IHW20N65R5	IHW20N120R5	IHW20N135R5		IEWS20R5135IPB	
25		IHW25N120E1						
30			IHW30N65R5	IHW30N120R5	IHW30N135R5	IHW30N160R5		
40			IHW40N65R5 (*)	IHW40N120R5	IHW40N135R5			
50			IHW50N65R5					
Package		TO247-3	TO247-3	TO247-3	TO247-3	TO247-3	TO247-6	
Recommended Driver IC		1ED44175N01B	2ED218x	1ED44175N01B			Co-packed driver with protection functions	

*available also in advanced isolation package: IHFW40N65R5S

Why to use Infineon's products?

Low power losses

- › High energy efficiency

Soft switching slopes

- › Excellent EMI behavior

Highest quality standards

- › High system reliability

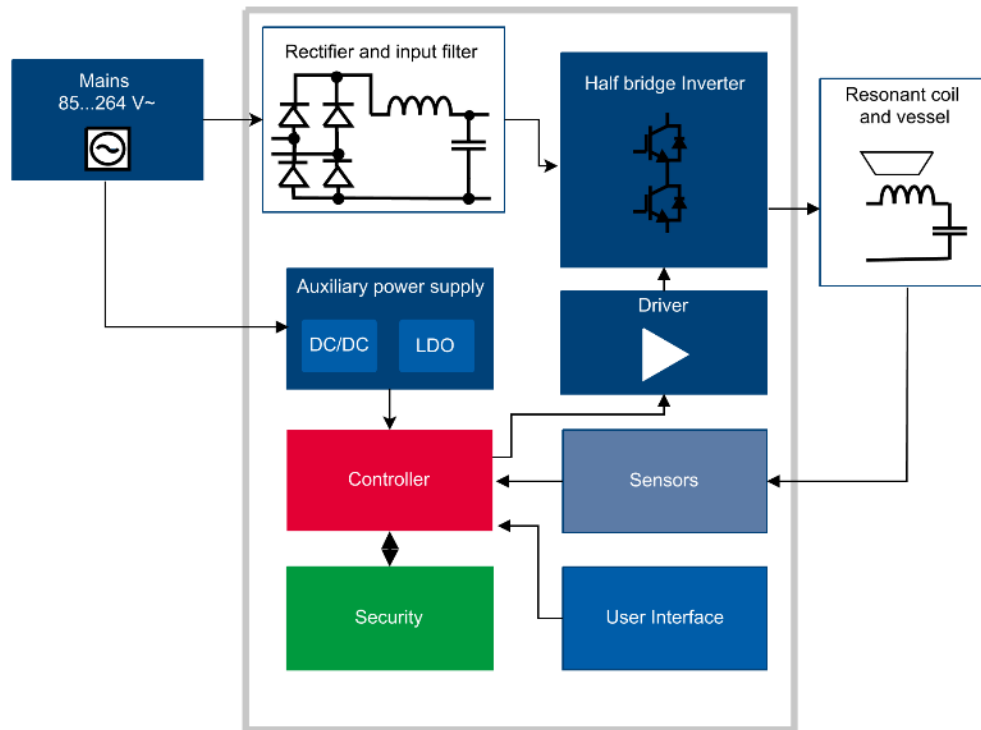
State-of-the art technologies

- › Competitive appliances

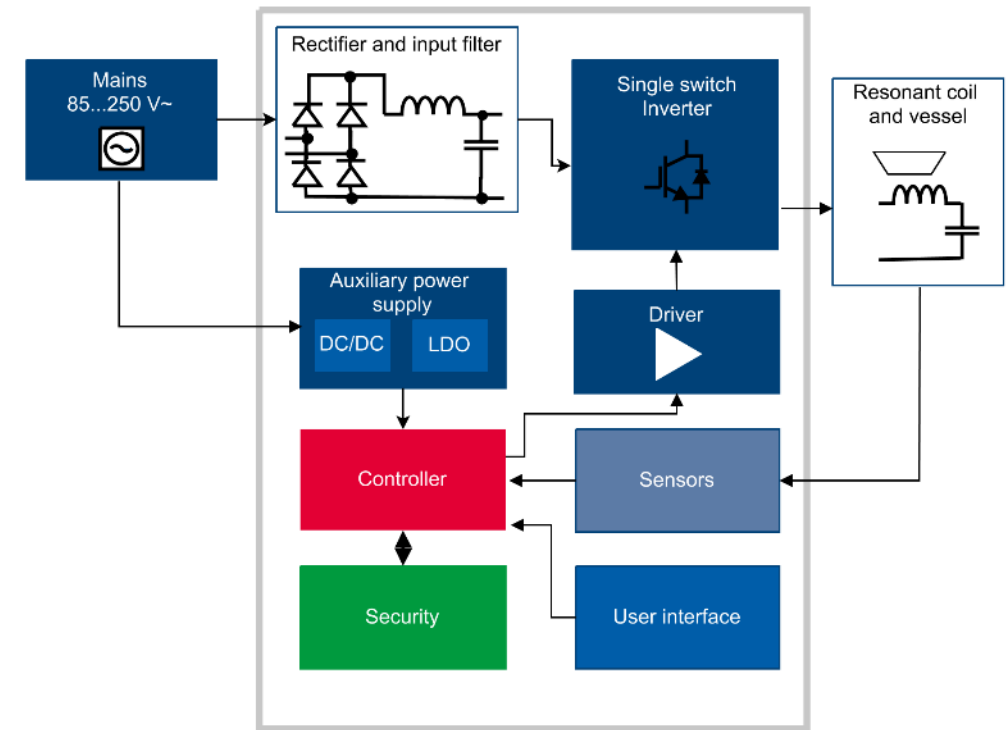


Induction cooking topologies







Half-bridge topology



Single-switch topology



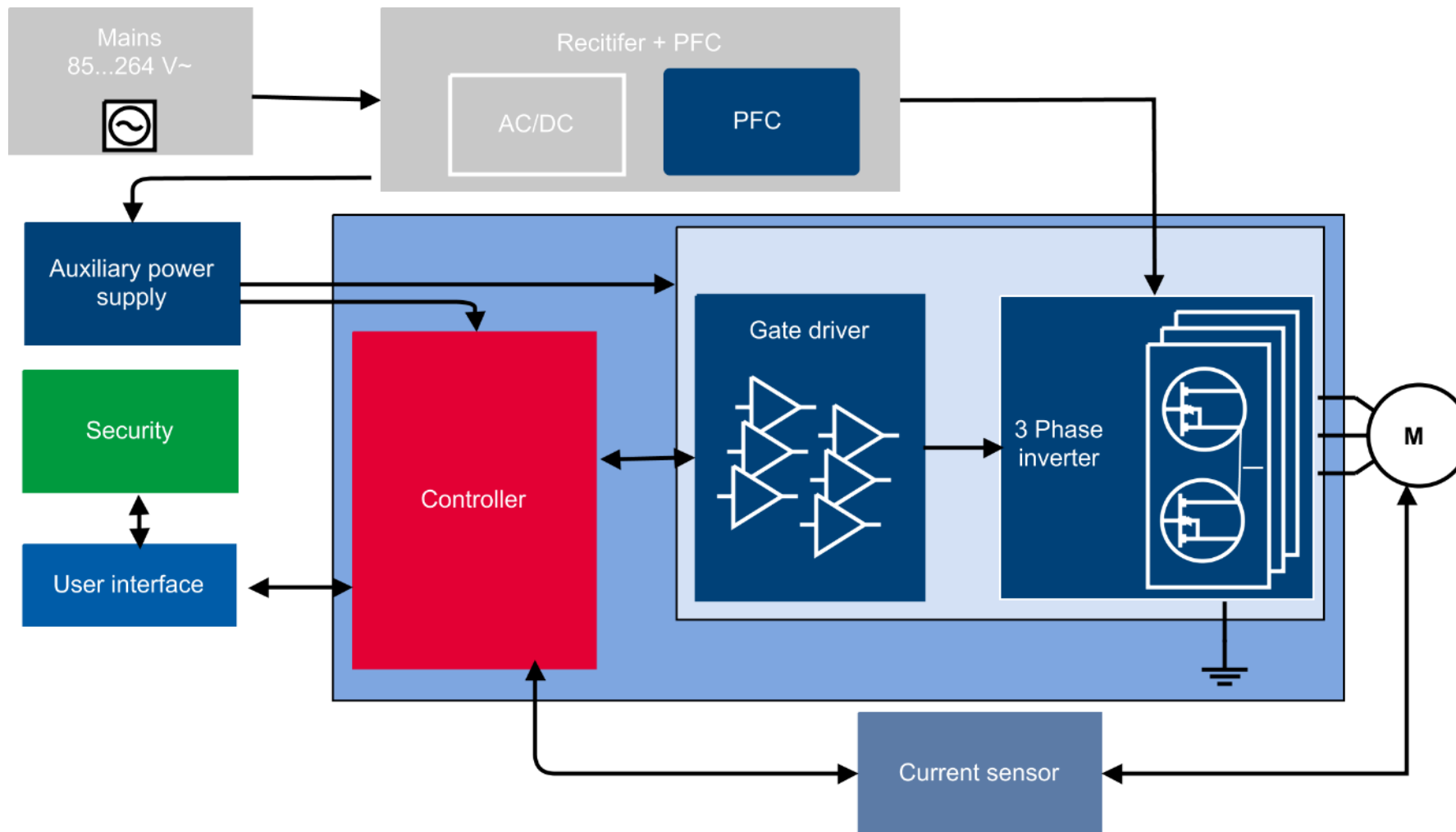
Infineon solution overview for induction heating

		Induction cooking	
		1500 W	2200 W
	Inverter switches	TRENCHSTOP™ RC-H5 IGBTs	
		IPD Protect	
	Gate driver ICs	650 V SOI Level shift gate driver ICs	
		Single channel low side driver ICs	
	Microcontrollers	XMC™ / Cypress PSoC® 4 series	
	Driver & auxiliary power supply	Integrated power stage – CoolSET™ Linear voltage and DC/DC switching regulators	
	C. sensors	XENSIV™ - high-precision coreless current sensors for industrial applications	
	Security	OPTIGA™ Trust product family	

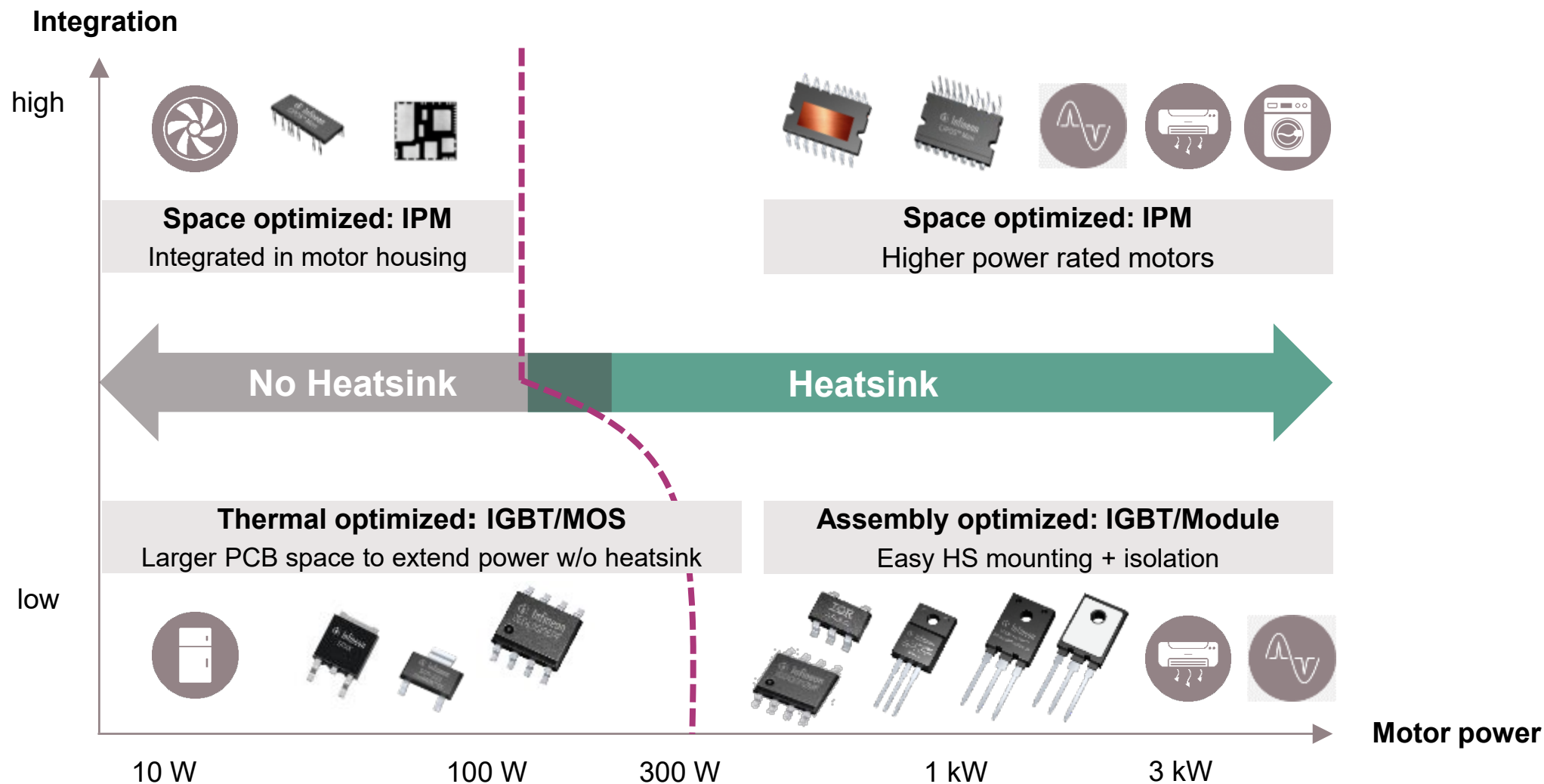
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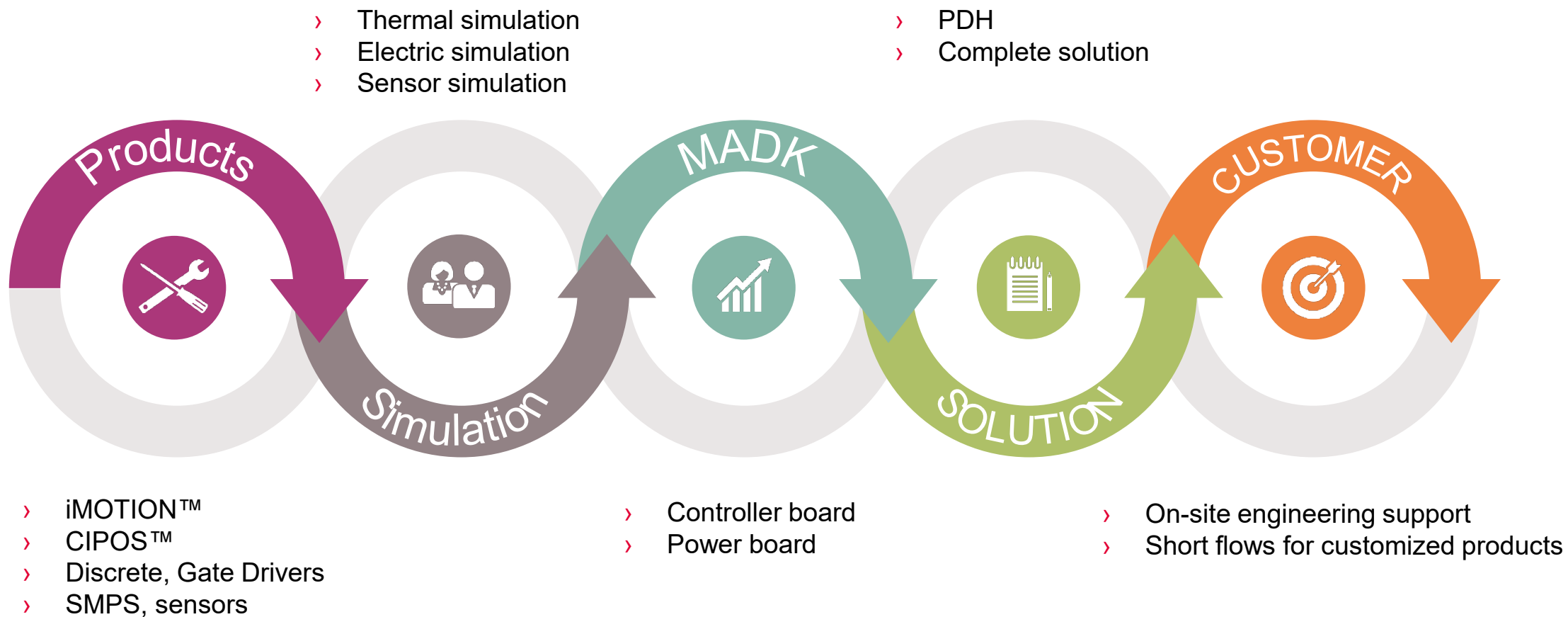
Constantly growing feature set in home appliance applications



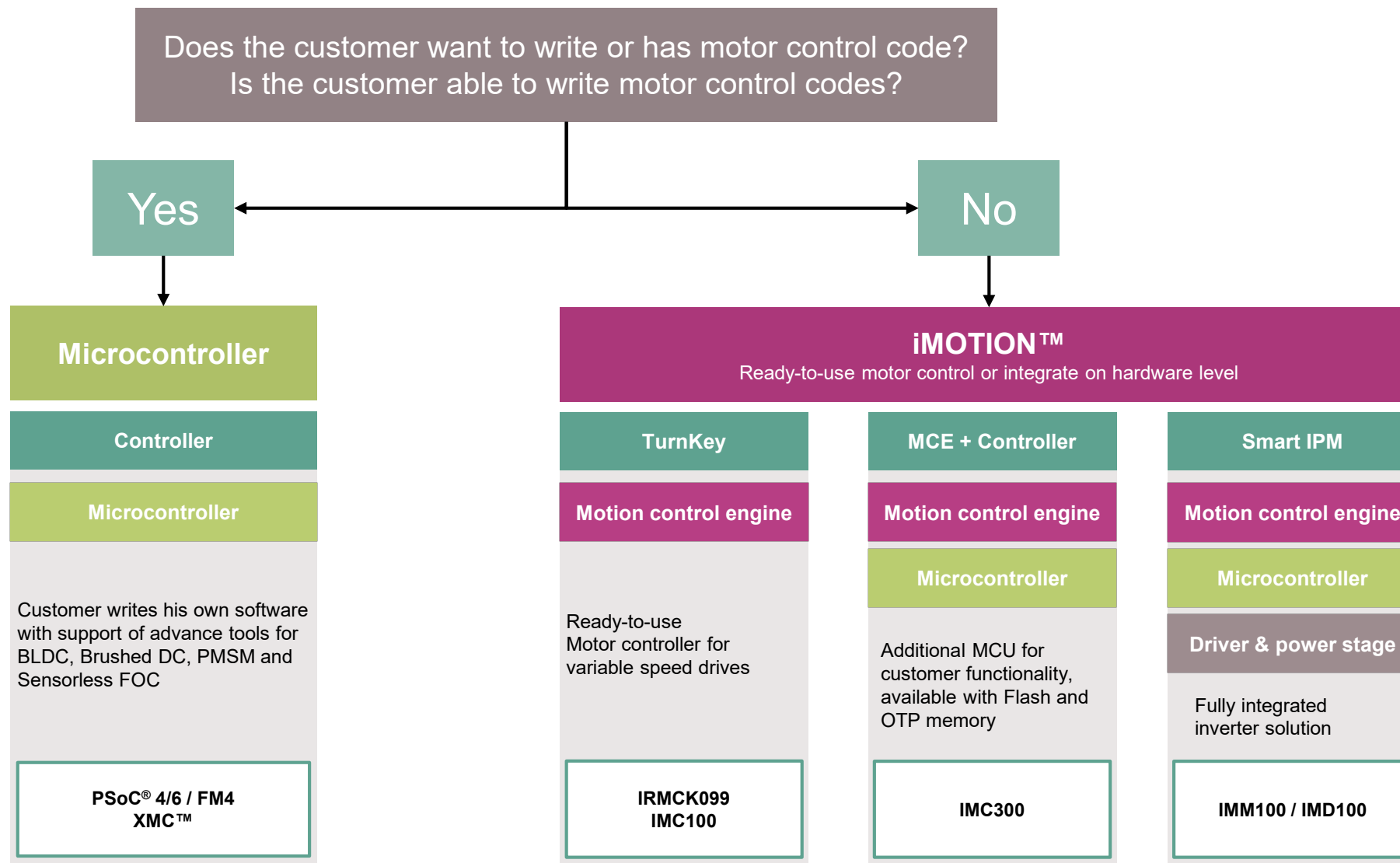
Solutions for consumer motor drives: Discretes or IPM inverters



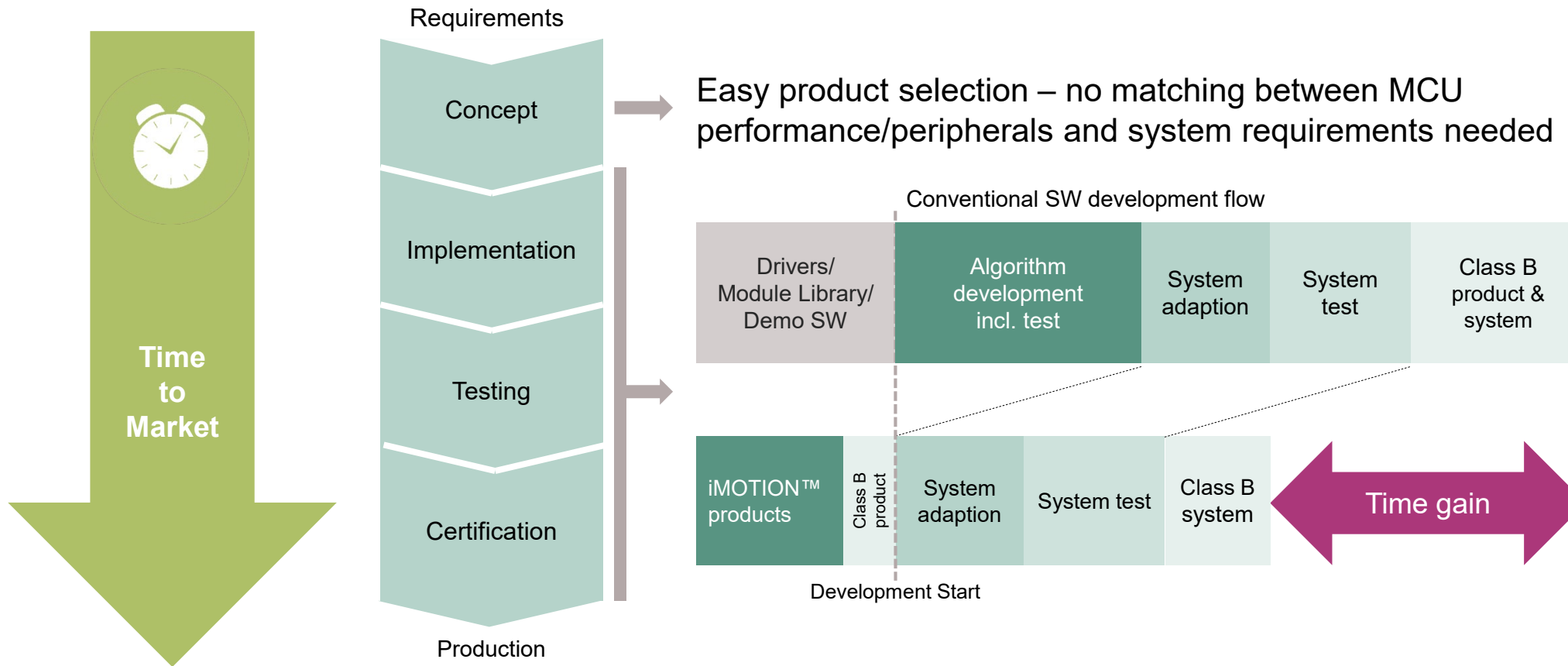
Infineon's comprehensive offering for motor control



Motor control: iMOTION™ or Microcontroller?



iMOTION™ reduces significantly time & resource needs in the overall motor & PFC software development cycle



Major benefits – Significant time to market improvement

- › Simplified product selection
- › State of the art algorithms – production ready & UL/ClassB pre-certified
- › RnD cost savings of ~\$180k (Assumption: 12 MM a \$15k)

Microcontroller portfolio for small home appliance

User Case	Range hood	Water heater	Water purifier	Air purifier	MWO
Part numbers	CY8C4025/S1 CY8C4126/S2	CY8C4014/S0 CY8C4025/S1 CY8C4126/S2	CY8C4025/S1 CY8C4126/S2 CY8C4127/S3	CY8C4014/S0 CY8C4147/S3	CY8C4014/S0 CY8C4148/S3
Product characteristics	Flash: 32K~64K SRAM: 4K~8 UART: 2~4 Capsense: 6~12 Support slides ADC:3	Flash: 16K ~ 64K SRAM: 2K~8K UART: 1~3 Capsense: 4~8 ADC:4	Flash: 32K ~ 128K SRAM: 4K~32K UART: 2 Capsense: 4~6	Flash: 16K, 128K SRAM: 2K, 16K GPIO: 12~55 UART: 1~4 Capsense: 4~8	Flash: 16K, 256K SRAM: 2K, 32K GPIO: 12~55 UART: 1~4 Capsense: 9~18
Key features	Good capsense performance Ease use turnkey Support OTA, 5V power supply, 32bit M core	Good capsense performance Ease use turnkey Enable LCD 5V Power supply	Good Capsense performance Ease use turnkey Support OTA, 5V Power supply	Good Capsense performance, Support OTA, 5V power supply, 32bit M core	Good Capsense performance, Support OTA, 5V power supply, 32bit M core

Infineon selection guide for motor drive inverter power stage <300 W

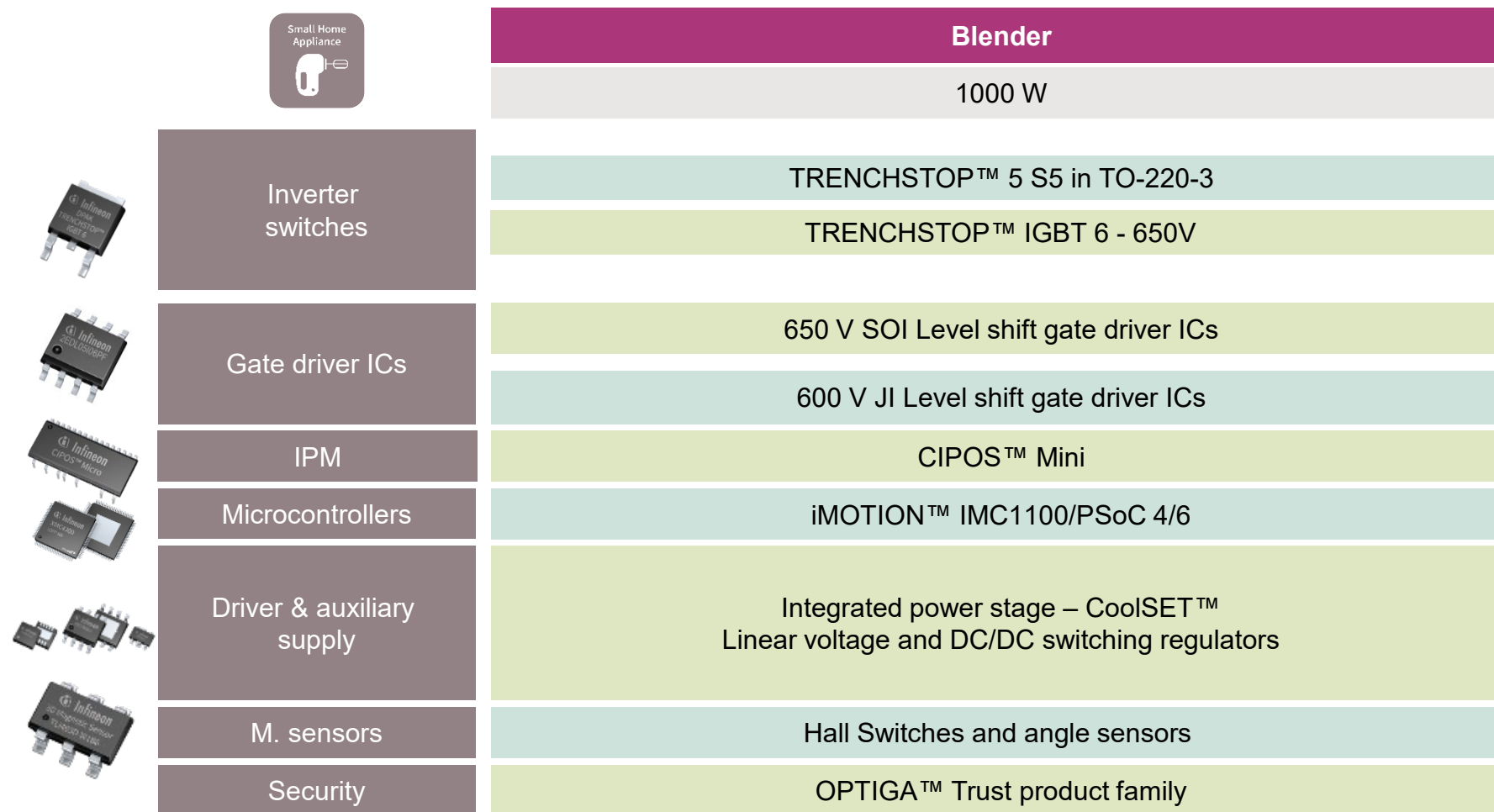
iMOTION™ / PSoC® 4/6 / XMC™			Features	
Discrete IGBTs	CoolMOS™	CIPOS™		
<ul style="list-style-type: none"> › Better thermal management, easier to dissipate the losses in the PCB without heatsink › Better cost position (second sourcing, discrete are cheaper) › Flexible EMI noise vs. performance tuning by gate resistance selection 			<ul style="list-style-type: none"> › Fridge Compressors, Ceiling Fans, Hair Drier, Circulation Pumps, Air Purifier, HVAC Fans › Heat dissipation without the Heatsink › Usually Active PFC stage is not used › Usually sensor-less motor control › Current is sensed using single shunt in DC- or two shunts in the inverter branches 	
<ul style="list-style-type: none"> › Best EMI noise controllability 	<ul style="list-style-type: none"> › Best efficiency 	<ul style="list-style-type: none"> › Higher integration, reducing PCB/system size and BOM › Shorter time to market › Increased reliability 		
<ul style="list-style-type: none"> › TRENCHSTOP™ RCD (DPAK) › TRENCHSTOP™ RCD2* (DPAK, SOT223) › TRENCHSTOP™ IGBT6* (DPAK) 	<ul style="list-style-type: none"> › CoolMOS™ PFD7 (SOT223, DPAK) › CoolMOS™ CFD (DPAK) 	<ul style="list-style-type: none"> › iMOTION™ Smart IPM (PQFN) <80W › CIPOS™ Nano (PQFN) <205W › CIPOS™ Micro (DIP, SOP) <400W 		

* Available in Q1-2020

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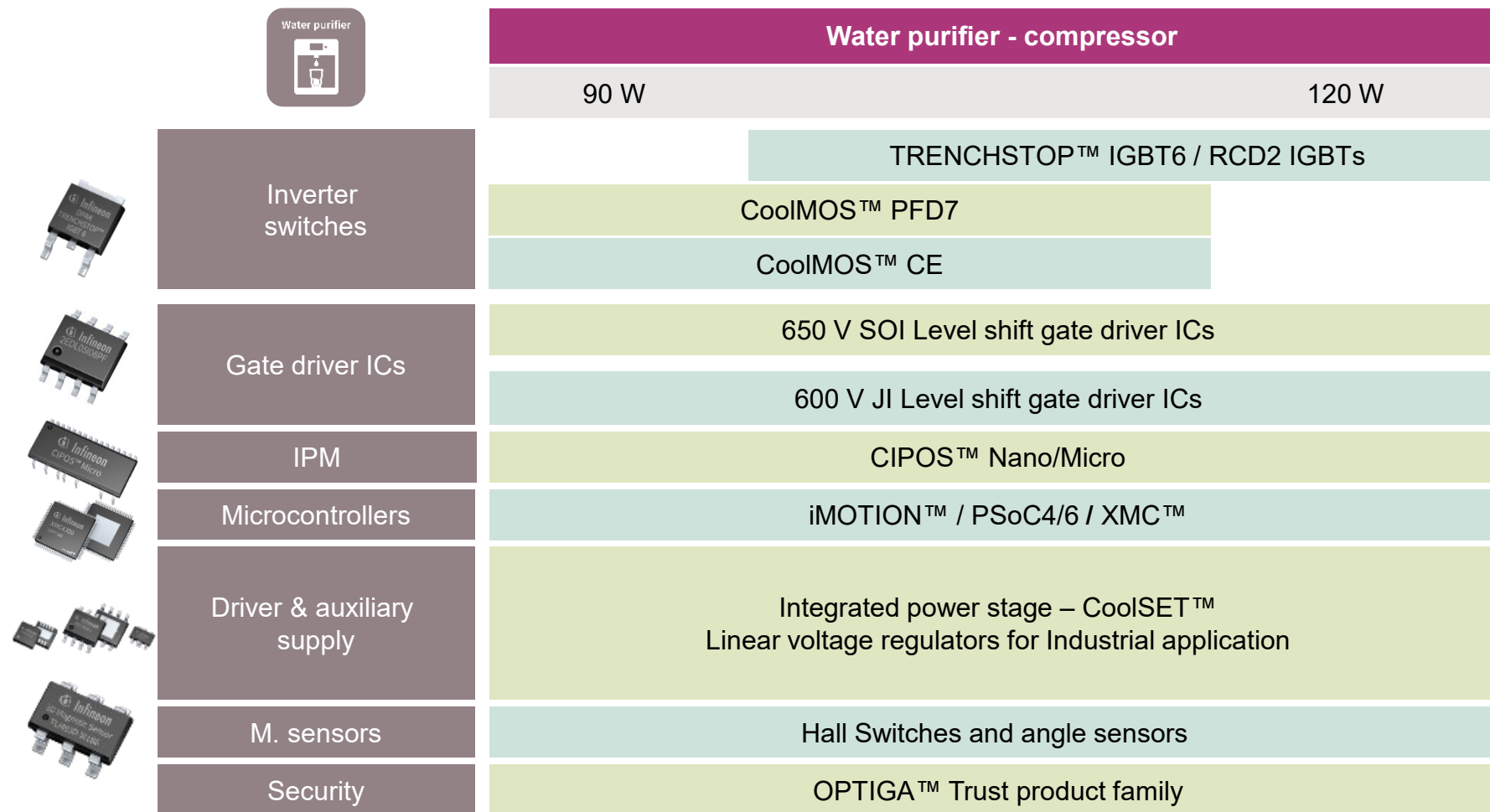
Infineon solution overview for blenders



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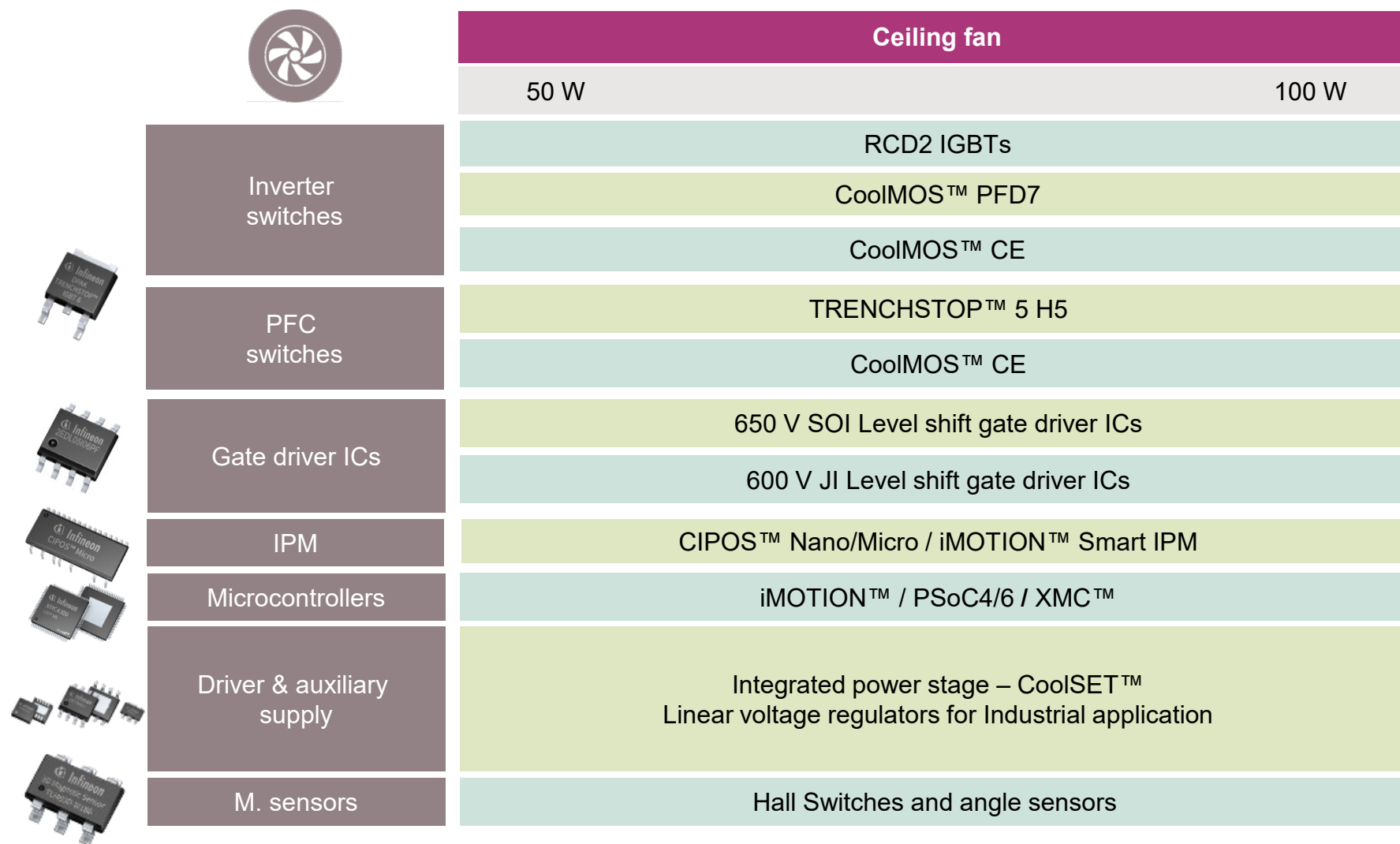
Infineon solution overview for water purifier



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Infineon solution overview for ceiling fan



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Conclusion and take-aways



- Infineon has the most comprehensive portfolio among competitors: One-stop-shop.
- Infineon offers energy efficient solutions, with different levels of integration to meet any customer needs.
- We can offer a competitive and complete system solution for traditional and new consumer drive applications.
- Smart functionality is offered beyond energy efficiency.
- Add hardware-based security already at product design and benefit from Infineon's support for an easy and fast integration.
- We are working together with our customers to grow into the future!**



Part of your life. Part of tomorrow.