



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

# Automotive Thermal Management

addressing challenges  
with auxiliary pumps and fans





# Agenda

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1

Thermal Management for xEV

2

Infineon Motor Control Offering

3

Reference Design



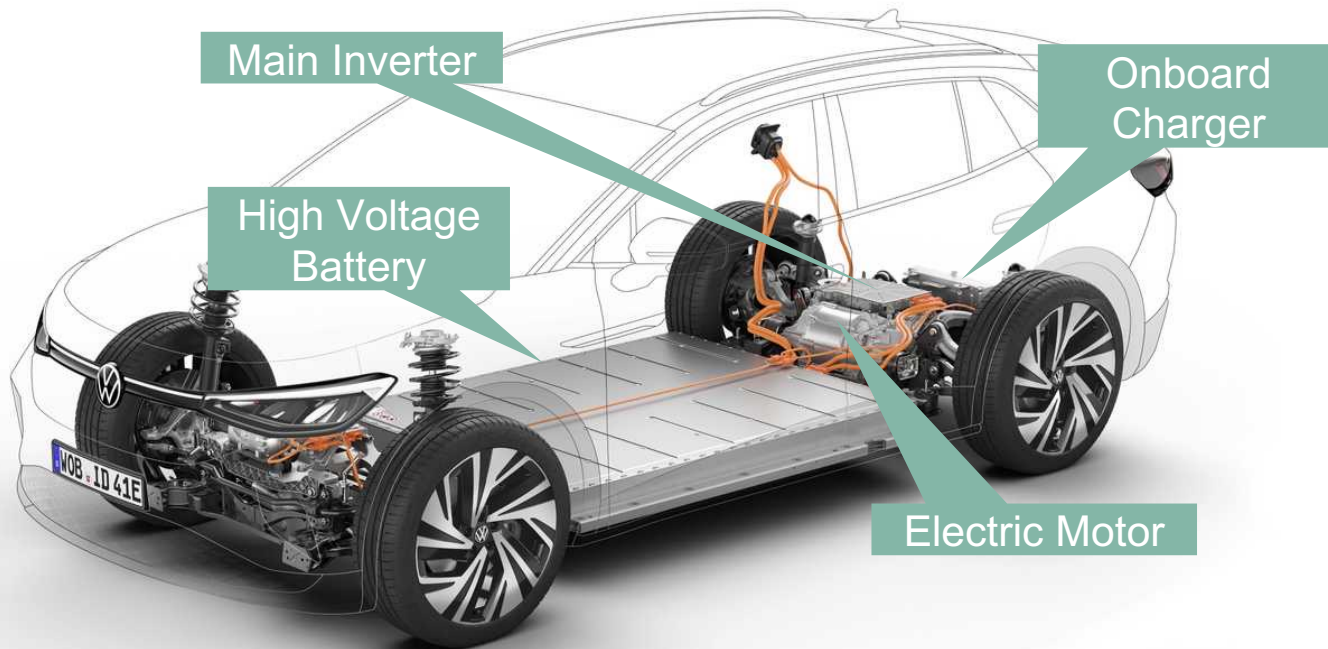
What are challenges?



# Automotive Thermal Management

## Example: Electric Vehicle

Source: (1)



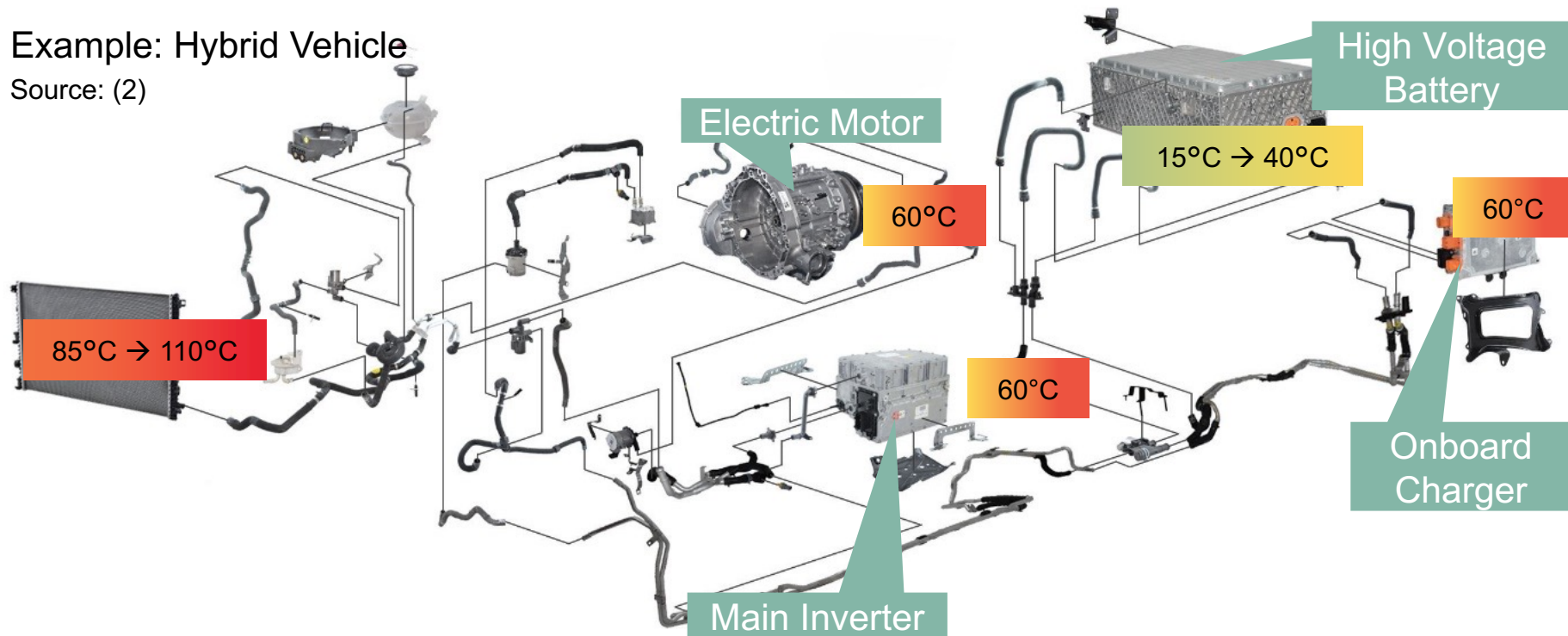
## Challenge 1: New system components and applications



# Automotive Thermal Management

## Example: Hybrid Vehicle

Source: (2)



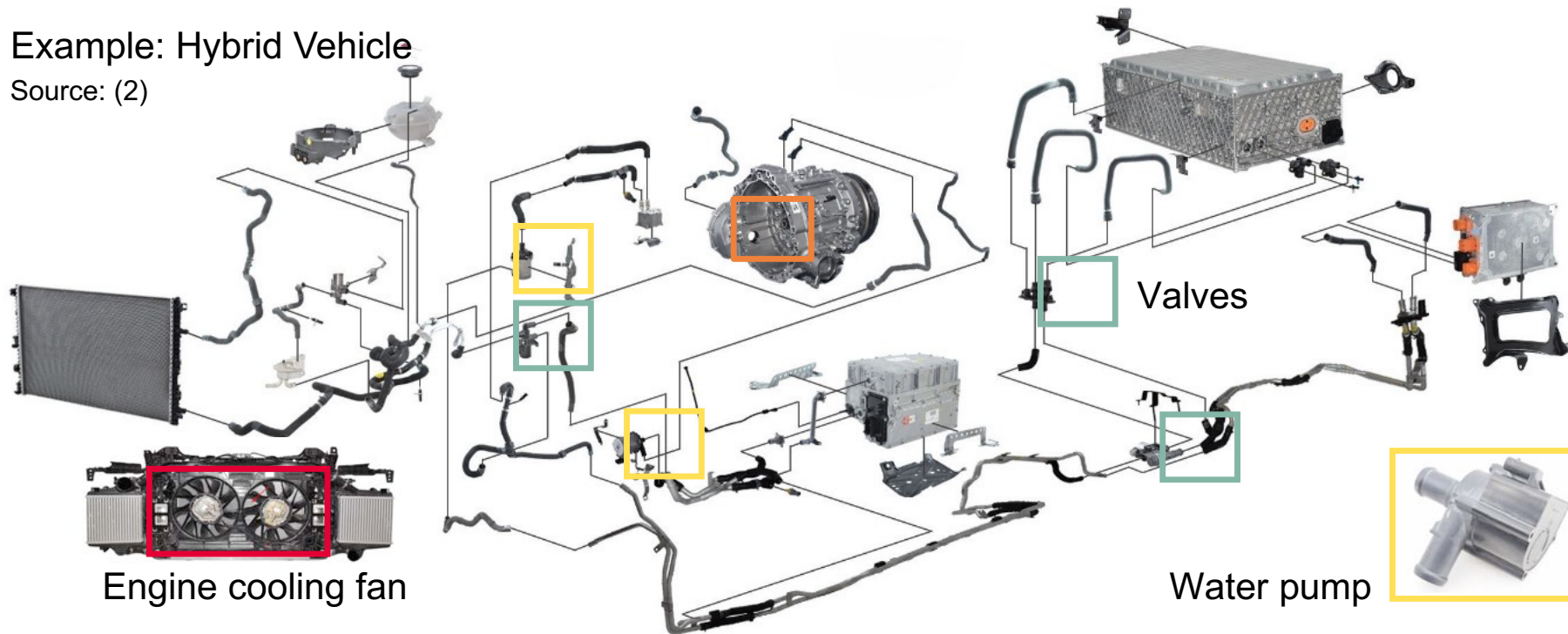
## Challenge 2: Different operation temperatures



# Automotive Thermal Management

## Example: Hybrid Vehicle

Source: (2)

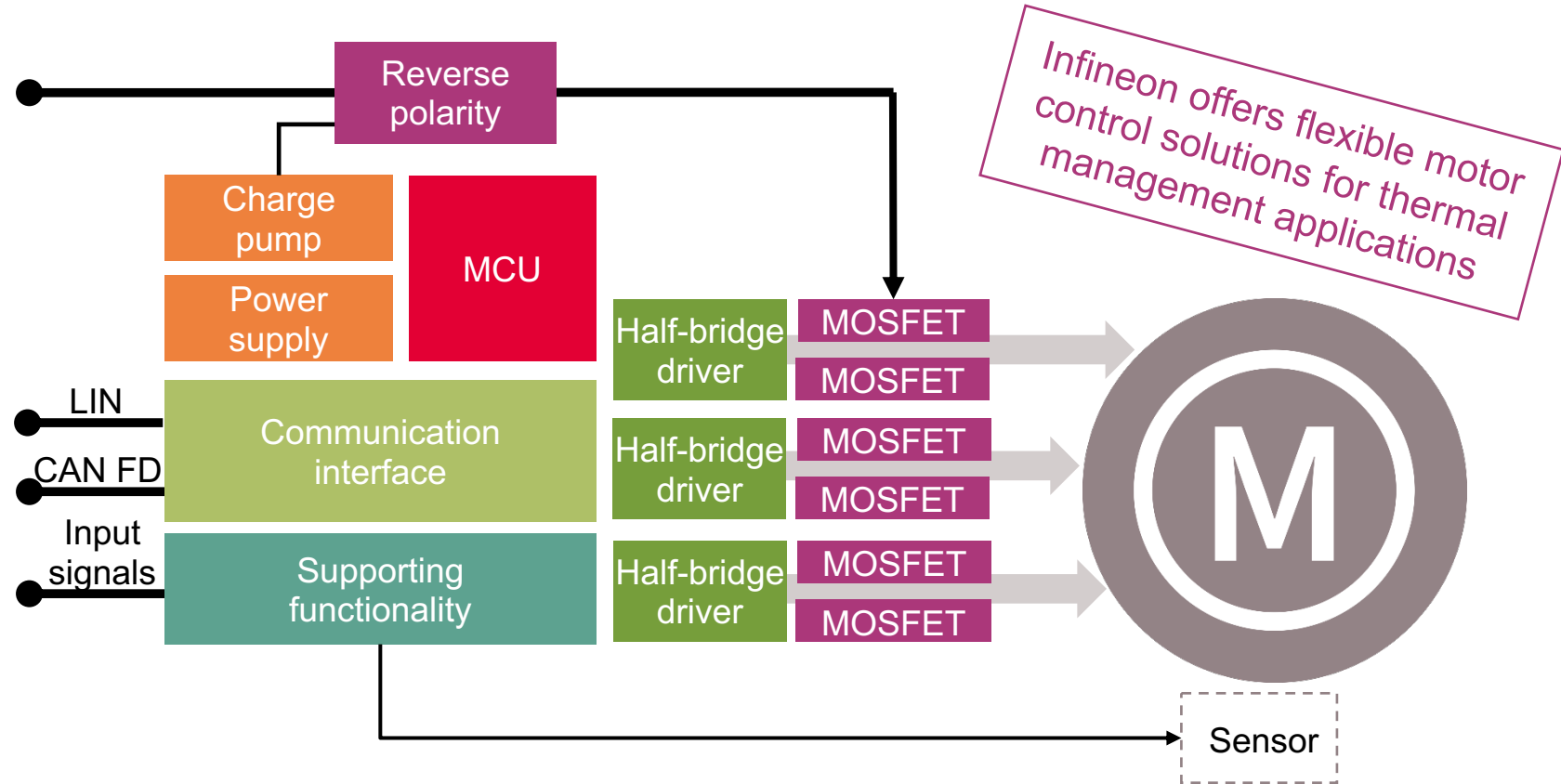


Thermal Management application power classes:



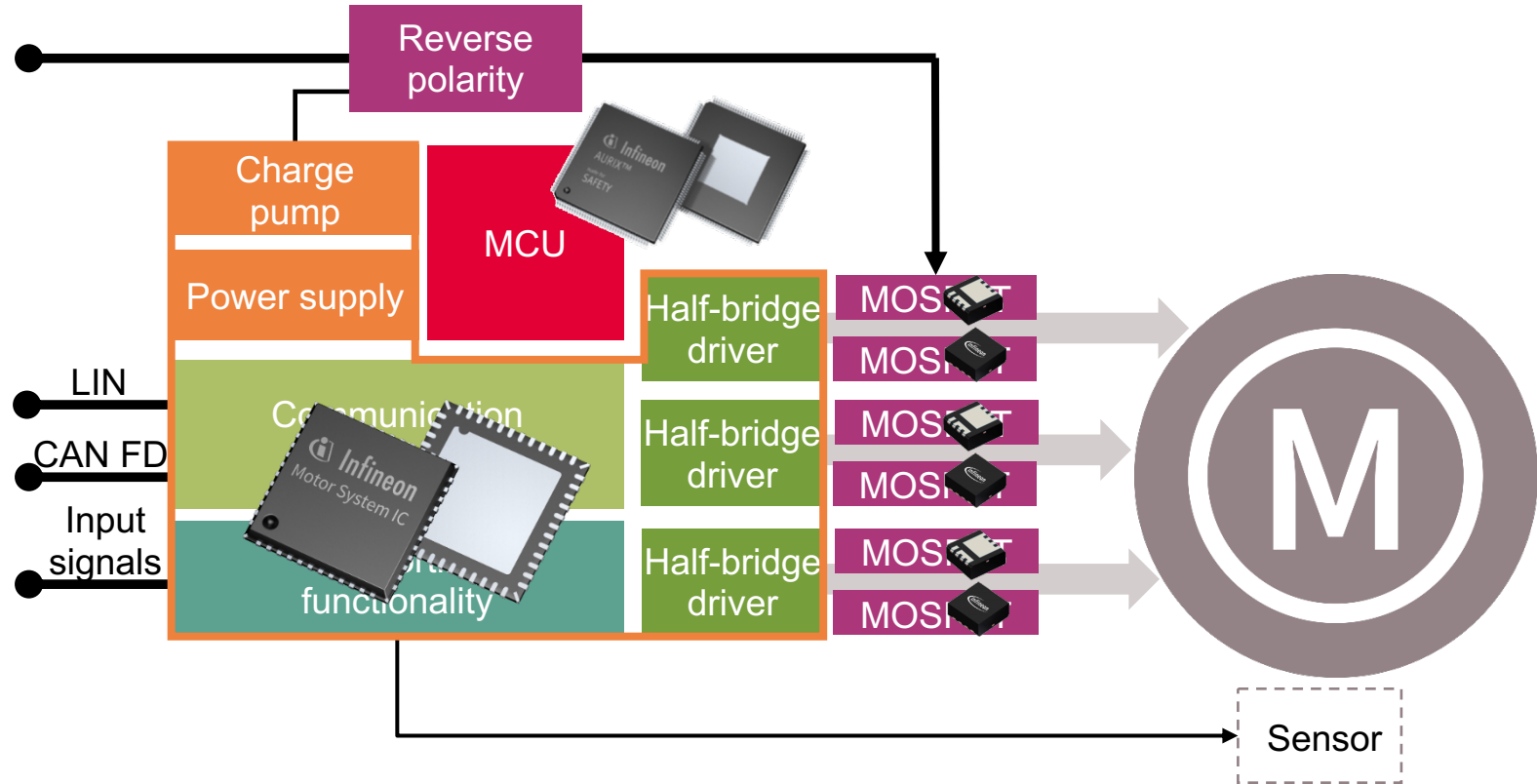


### 3 Phase ECU: low-integrated approach with discrete components





### 3 Phase ECU: medium-integrated approach with Motor System IC and standalone microcontroller





# Motor System IC portfolio

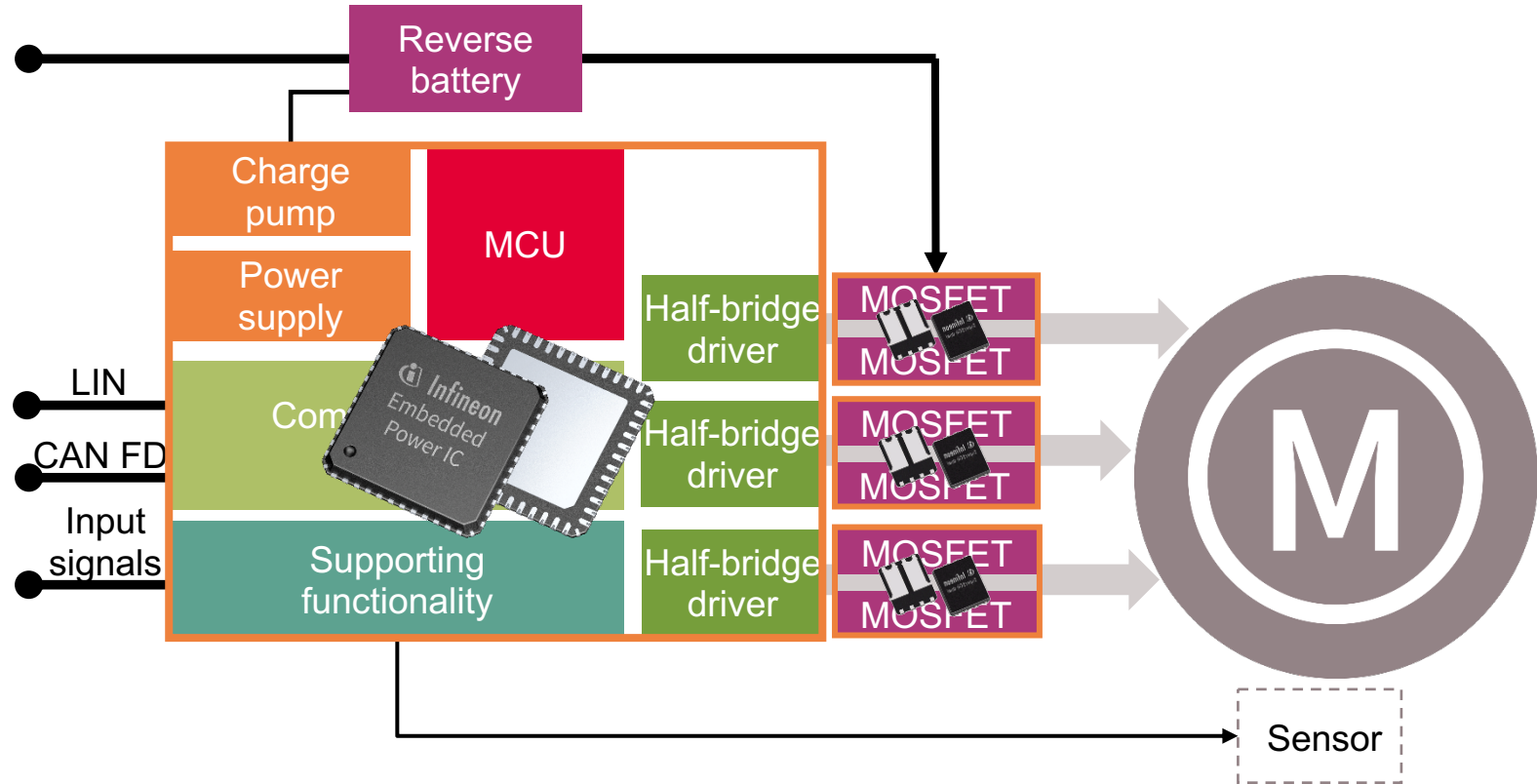


**PPAP in January 2021**

	<div>Motor Control</div> <div>(M)</div> <div>Brushed DC Motor</div>					<div>BLDC Motor</div> <div>Brushless DC Motor</div>	
Product	TLE9560-3QX	TLE9561QX	TLE9561-3QX	TLE9562QX	TLE9562-3QX	TLE9563-3QX	TLE9564QX
Motor	2x Half-Bridges	4x Half-Bridges	4x Half-Bridges	4x Half-Bridges	4x Half-Bridges	3 Phase BLDC	3 Phase BLDC
Current Sense Amplifier	—	—	—	—	—	√	√
PWM	1	4	4	2	2	6	6
HS Switches	4	4	4	4	4	3	3
Wake Inputs	1	Up to 5	Up to 5	Up to 4	Up to 4	2	1
Communication	1x CAN FD*, 1x LIN	1x CAN FD*	1x CAN FD*	1x CAN FD*, 1x LIN	1x CAN FD*, 1x LIN	CAN FD*	LIN 2.2
CAN PN	√		√		√	√	
Application	<div>Sunroof</div> <div>Lift gate</div> <div>Power Sliding Door</div> <div>Seat</div>					<div>Pumps</div> <div>Fans</div> <div>Transfer Case</div>	



### 3 Phase ECU: highly-integrated approach with Embedded Power IC + half-bridge MOSFETs





# Cortex M3 based Embedded Power with LIN/PWM



<b>B6 Driver</b>	256KB/8KB	9872(-2) QXA40 <sup>+</sup> PWM & LIN 40 MHz SD-ADC		9872QTW40 PWM & LIN 40 MHz
	128KB/6KB	9879(-2) QXA40 PWM & LIN 24/40 MHz SD-ADC	9879 QXW40 PWM & LIN 40 MHz	9879 QTW40 PWM & LIN 40 MHz
	64KB/6KB	9877 QXA20/40 PWM & LIN 24/40 MHz	9877 QXW40 PWM & LIN 40 MHz	9877 QTW40 PWM & LIN 40 MHz
	48KB/3KB		9873 QXW40 PWM & LIN 40 MHz	
	36KB/3KB	9871QXA20 PWM 24 MHz		
<b>H-Bridge Driver</b>	256KB/8KB	9862 QXA40 PWM & LIN 40 MHz		
	128KB/6KB	9869QXA20 PWM & LIN 24 MHz		
	128KB/4KB	9868QXB20 PWM & LIN 20 MHz SD-ADC		
	64KB/6KB	9867QXA20/40 PWM & LIN 24/40 MHz	9867QXW20 PWM & LIN 24 MHz	
	36KB/3KB	9861QXA20 PWM 24 MHz		
Flash/RAM		VQFN-48	VQFN-48	TQFP-48
Package				
		Grade-1	Grade-0	

## System on Chip

- › Arm® Cortex®-M3 processor
- › Smart Pre-driver
- › Power supply and Transceiver

## MCU Scalability

- › Performance & Flash
- › Software compatibility

## Analogue scalability

- › H-bridge and B6- Driver
- › PWM and LIN interface

## USP's

- › Portfolio PIN compatibility
- › Grade-1 and Grade-0
- › Up to 900W motor power control
- › Operation from  $V_{bat} = 6V$

In Production

Released & technical documents available online



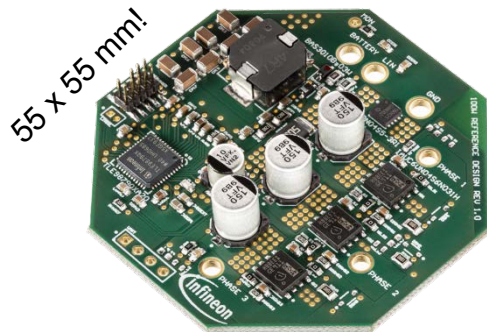


# Reference Design for Auxiliary Water Pump 100W

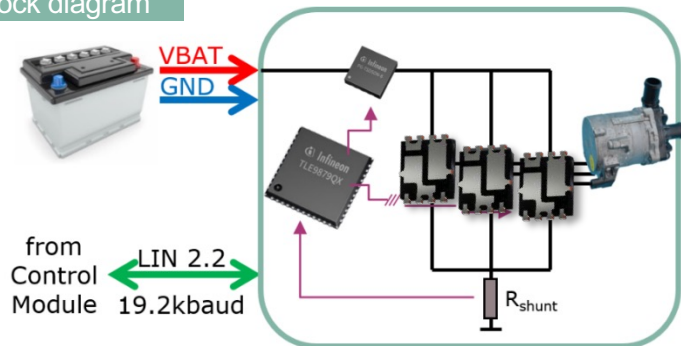
## Reference board

### Scope of Reference

- › EMC optimized
- › Thermally optimized
- › Component optimized
- › Size optimized



## Block diagram



- › TLE9879QXW40 – Embedded Power  $\mu$ C
- › IAUC60N04S6N31H Half-bridge MOSFETs

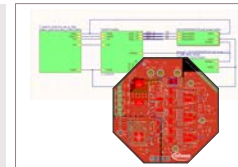
## User Manual

- › Getting Started
- › Hardware Design



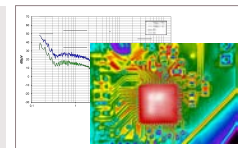
## Schematics & Layout

- › Schematics
- › Layout
- › Available for Altium Designer



## Evaluation Results

- › EMC Report (CISPR25)
- › Thermal analysis



## Software

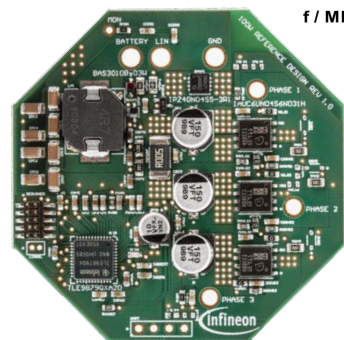
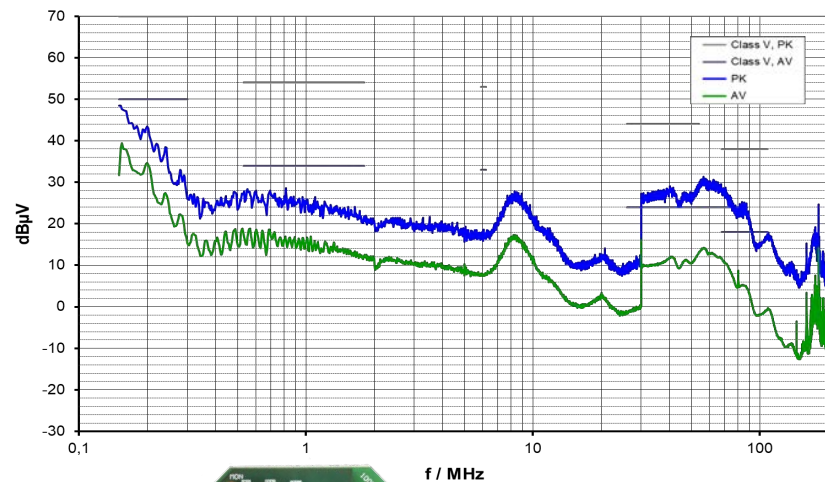
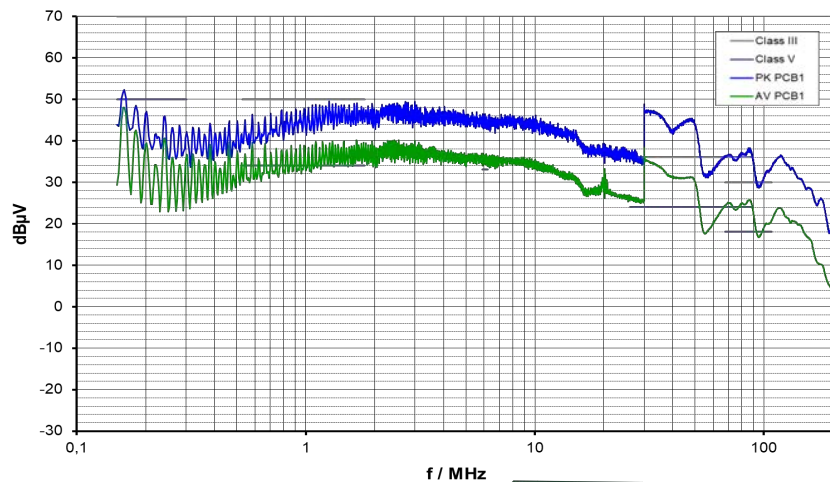
- › Example Software available
- ›  $\mu$ Vision 5 Project



Collaterals



# EMC optimization



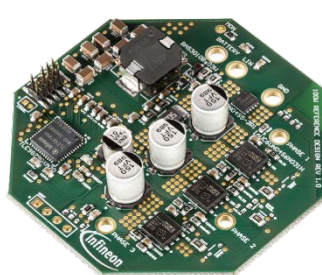
- + New ground concept
- + RC snubber added
- + Software optimisation
- + Galvanic coupling



# 100W Reference Design

## Ready for Shipment

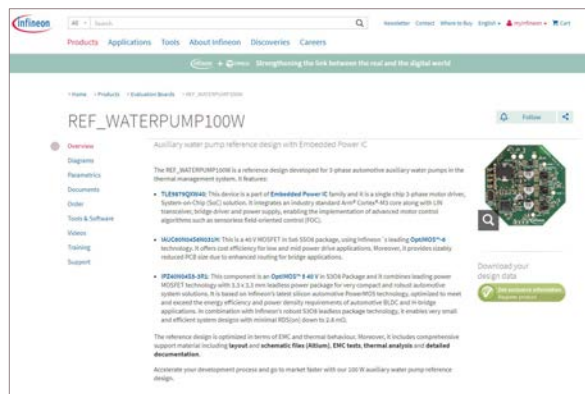
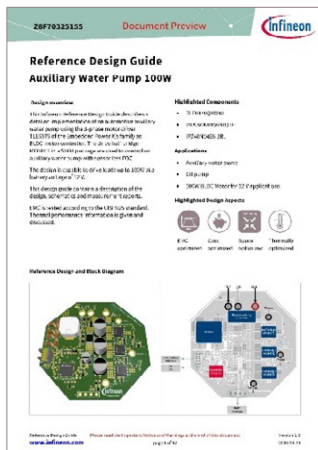
- › Website
- › Documentation
- › Gated Content
- › Boards
- › Boxes
- › Unboxing video



### Videos



Auxiliary water pump reference design up to #140 W  
Meet Infineon's auxiliary water pump reference design with Embedded Power IC. The reference design is an automotive 3-phase motor drive for auxiliary water pump application and it is capable to drive 12V BLDC motors up to 140W. Explore the features and benefits of our reference design and see an example demonstrator.



[www.infineon.com/refwaterpump](http://www.infineon.com/refwaterpump)

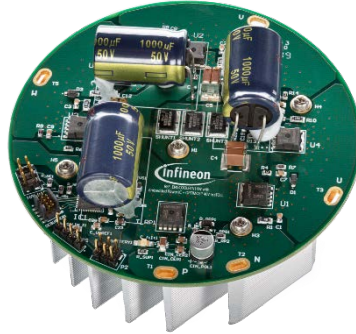


# Reference Design for a 12V 1kW Engine Cooling Fan Application

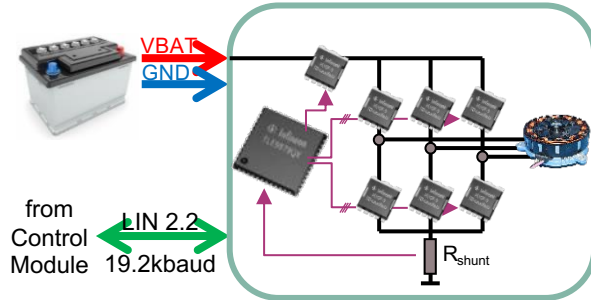
## Reference board

### Scope of Reference

- › 1kW functional
- › EMC optimized
- › Thermally optimized



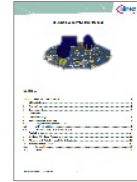
## Block diagram



- › TLE9879QXW40 – Embedded Power  $\mu$ C
- › IAUA250N04S6N007 sTOLL MOSFETs

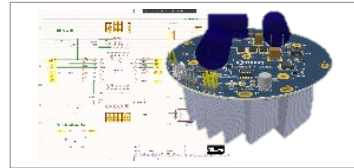
## User Manual

- › Getting Started
- › Hardware Design Guide



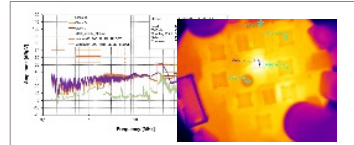
## Schematics & Layout

- › Schematics
- › Layout
- › Available for Altium Designer



## Evaluation Results

- › EMC Tests (CISPR25)
- › Thermal analysis



## Software

- › Example Software (SDK Motor control Demo)
- ›  $\mu$ Vision 5 Project



Collaterals



# Support material

	Collaterals & brochures	Technical material	Development tools	Videos / Distribution Trainings	
REF_ENGCOOLFAN1KW	<a href="#">Board page</a>	<a href="#">Documents</a>	<a href="#">Tools &amp; Software</a>	<a href="#">Videos</a>	<a href="#">Trainings</a>
REF_WATERPUMP100W	<a href="#">Board page</a>	<a href="#">Documents</a>	<a href="#">Tools &amp; Software</a>	<a href="#">Videos</a>	<a href="#">Trainings</a>
TLE9872QTW40	<a href="#">Product page</a>	<a href="#">Documents</a>	<a href="#">Tools &amp; Software</a>	<a href="#">Videos</a>	<a href="#">Trainings</a>
TLE9563-3QX	<a href="#">Product page</a>	<a href="#">Documents</a>	Currently no tools and videos available		<a href="#">Trainings</a>
TLE92108-231QX	<a href="#">Product page</a>	<a href="#">Documents</a>	<a href="#">Tools &amp; Software</a>	<a href="#">Videos</a>	<a href="#">Trainings</a>

Embedded Power IC
  Motor System IC
  Multi MOSFET Driver





Part of your life. Part of tomorrow.



# Sources

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- (1) VW ID4 Cutaway:  
<https://www.motor1.com/photo/5197608/2021-volkswagen-id4-technical-cutaway/>
- (2) Porsche Cayenne e-Hybrid 2018:  
<https://www.a2mac1.com/>
- (3) 100W Waterpump Reference Design:  
[www.infineon.com/refwaterpump](http://www.infineon.com/refwaterpump)
- (4) 1kW Reference Design:  
[www.infineon.com/refengcoolfan](http://www.infineon.com/refengcoolfan)