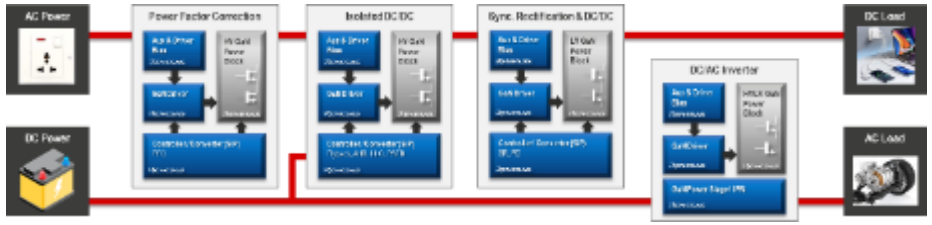
RENESAS GAN APPLICATION

Aug, 2025

RENESAS GAN | ONE-STOP SHOP FOR COMPLETE SYSTEM SOLUTION

Overview

- One-stop-shop for **complete system solution**
- Few **Watts** to **50+ kilo-Watts** applications
- Broad **AC-DC**, **DC-DC**, **DC-AC** applications
- RENESAS + transphorm + iWatt
- Best-in-class **GaN Ecosystem**

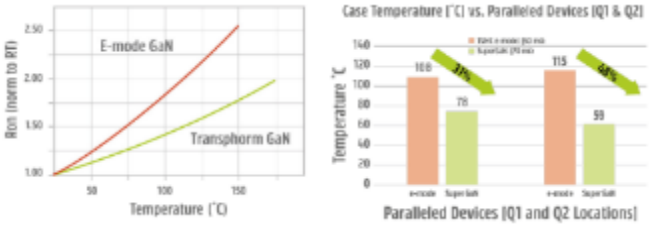


Why 'Renesas GaN'?

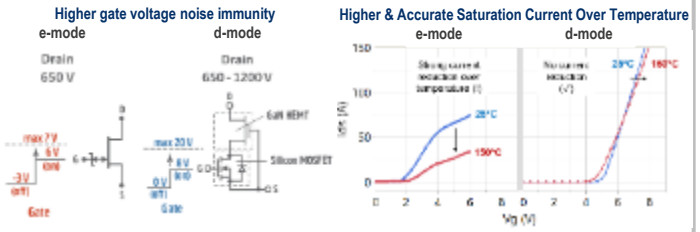
Best-in-class Efficiency & Thermal Performance

✓**Lower Losses & superior dynamic performance**

✓**Superior thermal performance**



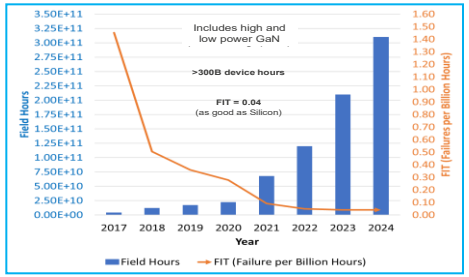
✓**Inherent Robustness and Easy to Drive**



GaN Quality & Manufacturing

Unmatched Quality & Reliability

✓**300 Billion+ hours** of field reliability hours
✓**20+ million GaN products** deployed in real-life use
✓Total **FIT <0.04** failures per billion hours
✓**JEDEC** & **AEC-Q101** qualified



Risk-mitigated geo-diverse multi-fab/AT strategy

✓Internal epi manufacturing
✓Internal & external wafer fabrication & Assembly/Test
✓Scaling up for growing demand (sites & 8")

RENESAS GAN | PRODUCT PORTFOLIO & INVESTMENTS

GaN Discrete Product Portfolio & Roadmap

Broad high-power – high voltage GaN package offering
including **Leaded** & **Top-side Cooling**

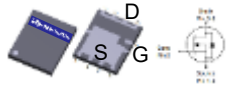
30 W to 250 W | 0.3 kW to 2 kW | 1 kW to 3 kW | 1 kW to 10+ kW

DPAK	PQFN56	PQFN88	TO-220	D²PAK	TOLT	TOLL	TO-247-3	TO-247-4
480 mΩ	480 mΩ	480 mΩ	240 mΩ	50 mΩ	72 mΩ	85 mΩ	50 mΩ	50 mΩ
240 mΩ²	240 mΩ	240 mΩ	150 mΩ		50 mΩ	72 mΩ	35 mΩ	35 mΩ
	150 mΩ	150 mΩ	85 mΩ		30 mΩ	50 mΩ	15 mΩ	
		85 mΩ	72 mΩ			35 mΩ		
		72 mΩ						

HV GaN – Continued Investments

- **Bidirectional**
- **650V Gen 6** (+20% FoM)
- **650/750V Automotive**
- **8” wafer transfer**

LV GaN – New Investments



- **40/100/200V**
  - **1st WS (Q3’25): 100V, 2/4/6 mΩ**
- **Bidirectional 40V, 100V (Q2’26)**
- **8” wafer**

GaN Ecosystem Product Portfolio & Roadmap

- Industry leader in **USB** & **Lighting** applications
- Expanding portfolio to **Aux Bias GaN SiPs**, **Smart GaN power stages** & **Best-in-class Controllers**

Low Power <100W

Key Focus: **BoM Cost**, **Ease-of-use (integration)**

Product Portfolio
- Flyback Converters – 5W-20W
- Flyback Controllers – DCM, QR, ZSP, PSR, SSR
- SR / PD Controllers
- Backlighting Controllers
- Optical Drivers

Product Roadmap
- Flyback – 25W-65W PSR/SSR GaN SiP
- SR / PD – Multi-port Controllers
- LV GaN Power Stages (OVP, LIDAR)

Key Applications

USB-PD | Backlighting | Aux Supply

Medium Power 100W – 600W

Key Focus: **Power Density**, **Noise**, **Ease-of-use**

Product Portfolio
- Flyback Controllers – ZVS
- PFC Controllers – Boost
- SR / PD Controllers – 48V EPR
- Solid State Lighting Controllers

Product Roadmap
- PFC-Flyback Controllers + GaN SiPs
- PFC – Interleaved Controllers + GaN SiPs
- Iso DC-DC Controllers – AHB, LLC + GaN SiPs
- SR Controllers (2-Channel, Q-grade)

Key Applications

USB-PD | Solid State Lighting | AC/DC

High Power 400W – 20kW+

Key Focus: **Robustness**, **Reliability**, **Power Density**

Product Portfolio
- PFC Controllers – CCM

Product Roadmap
- GaN Driver – HV / Isolated
- GaN Power Stage / 3-Phase IPM
- PFC Controllers – Totem-Pole
- FB-LLC Controllers

Key Applications

Industrial | xEV | Infrastructure

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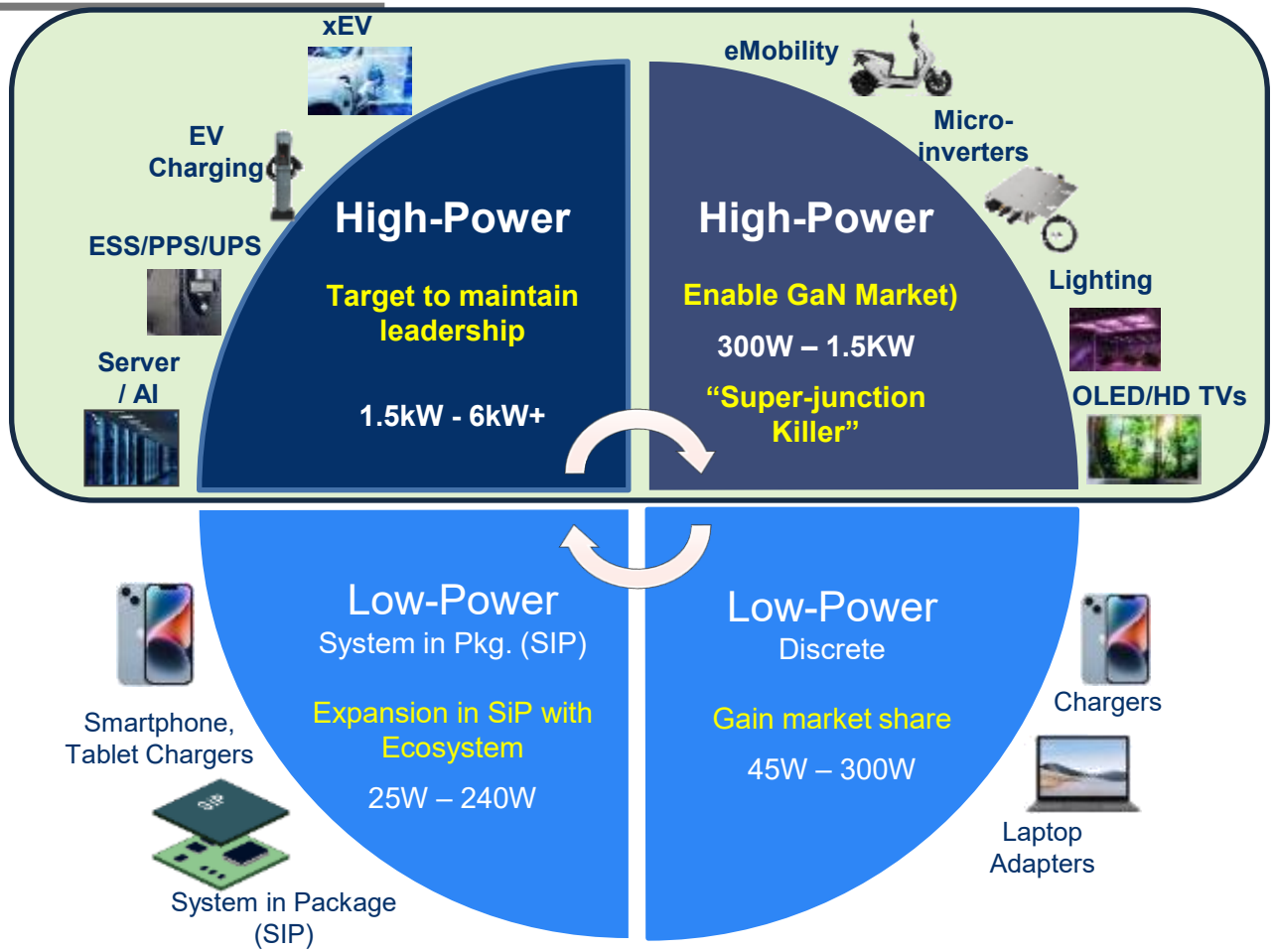
GAN: FOCUS MARKETS FOR HIGH POWER – INFRASTRUCTURE, ENERGY/INDUSTRIAL AND E-MOBILITY/XEVS



Controllers + Drivers (500W – 50kW+)

Key Focus: **Robustness**, **Reliability**, **Power Density**

Product Portfolio – *Production / Sampling*

- PFC Controllers – CCM
- GaN Driver – HV Half-bridge – Dec-25 Production
- Gate Driver – xEV Traction

Product Roadmap – *Future*

- PFC Controllers – Totem-Pole, CrM
- FB-LLC Controllers
- GaN Driver – HV, Isolated
- GaN Power Stage / 3-Phase IPM

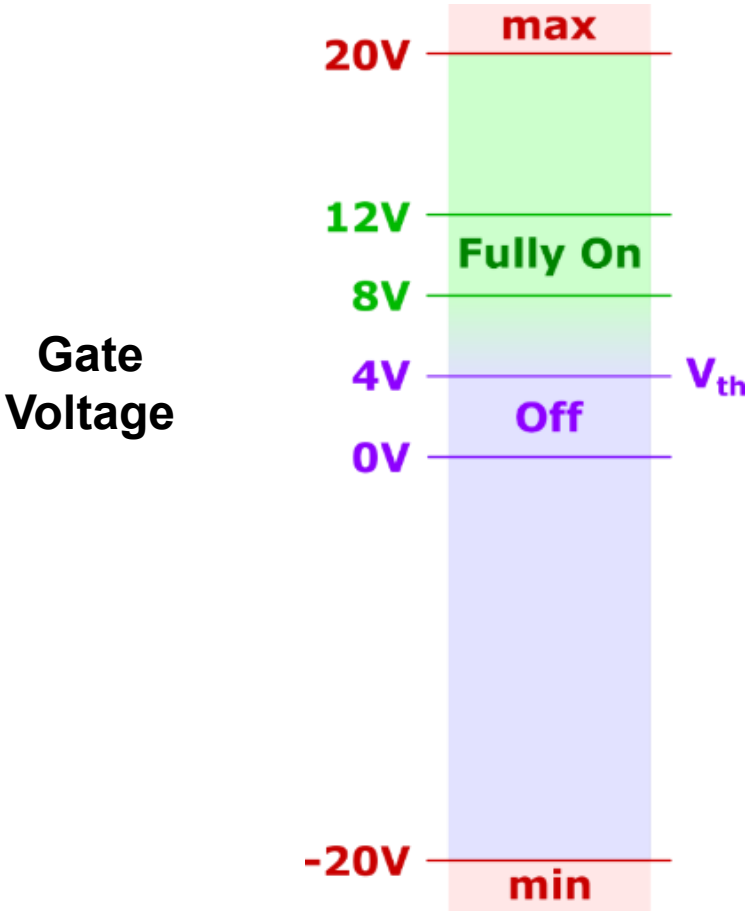
Key Applications

Industrial	xEV	Infrastructure

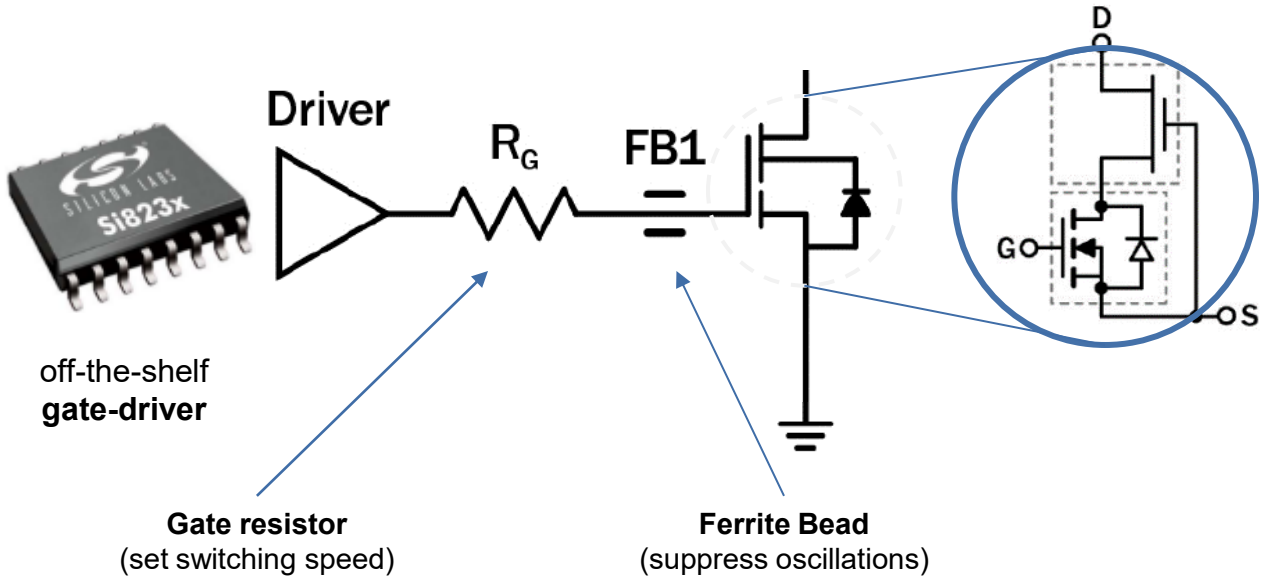
Proven GaN with Commercial Success in High Power Segments: Winning with a) High performance d-mode, 2) Robust, easy to drive, wide package range 3) Owned Epi and Wafer IP 4) Controller-Driver-GaN Combo roadmap

EASE OF DRIVING SUPERGAN FETS

Note: This shows the voltage drive for our high-power devices only



- ✓ High Threshold (4 V) ***(We also have 2 V Vth)***
- ✓ Fully-on at +8 to +12 V
- ✓ High Gate Rating (±20 V)
- ✓ Compatible with standard gate drivers



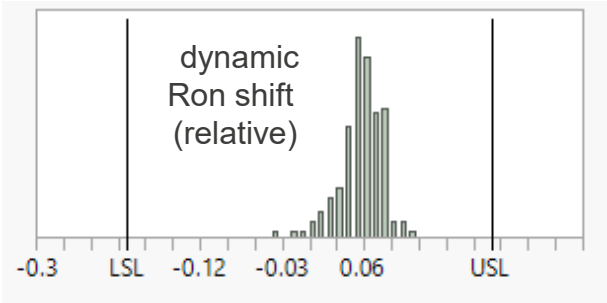
QUALIFIED AND RELIABLE GAN

JEDEC Qualified

AEC-Q101 Qualified

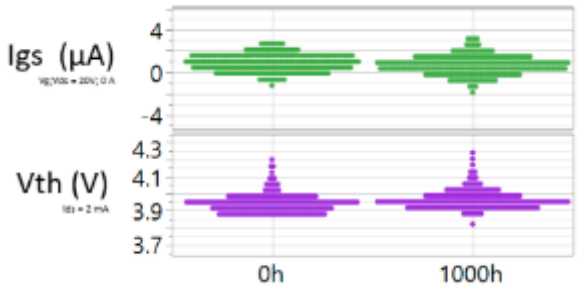
HTRB
1000h, 650-V
(3 lots, 77 parts each)

- No fuse failures
- No parametric failure

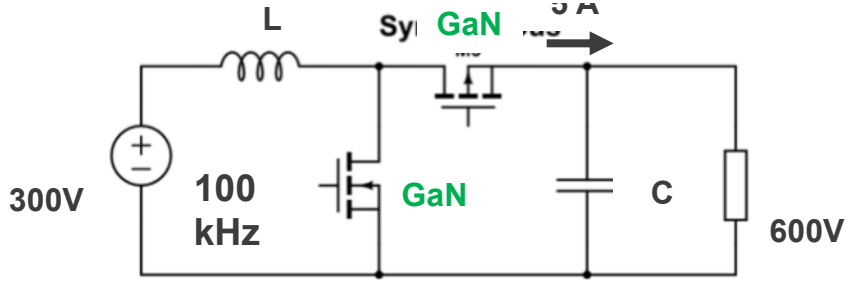


HTGB
1000h, Vg = 20V
(3 lots, 77 parts each)

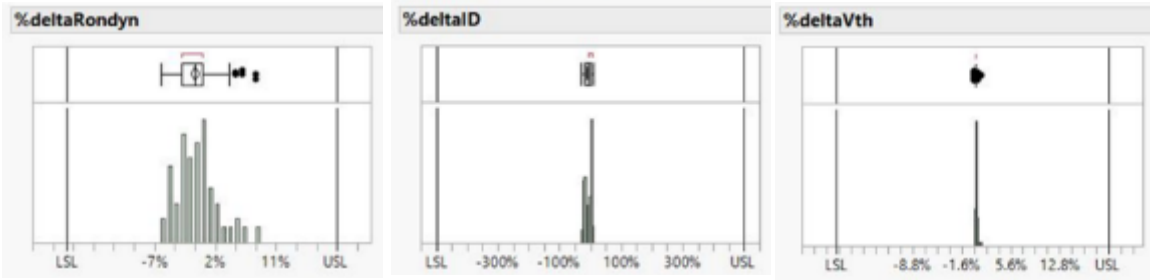
- No fuse failures
- No Vth & Ig shift



Beyond JEDEC/AEC: HTOL
(Hard switching Boost)
1000h, 600-V, 150°C



- No fuse failures
- No parametric failure
- No drift during HTOL



Low & stable Dynamic Ron

Very stable threshold

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1. HV GAN

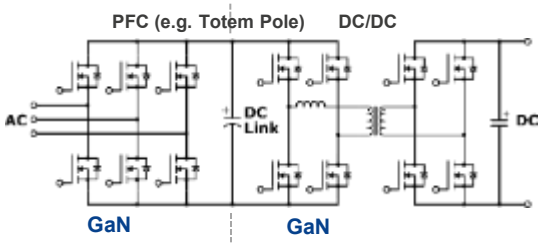
HIGH VOLTAGE GAN: 30W TO 10KW

HIGH-POWER MARKET: 1-3KW: LEADING GAN IN HIGHER POWER MARKET,

Applications: Lower Loss, System Cost and Size

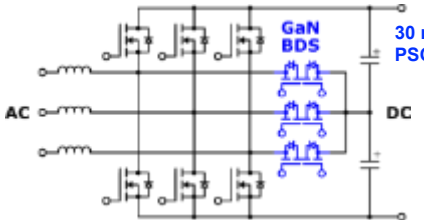
Automotive | Industrial (Battery Chargers) | Industrial (UPS) | Servers | Solar

Present

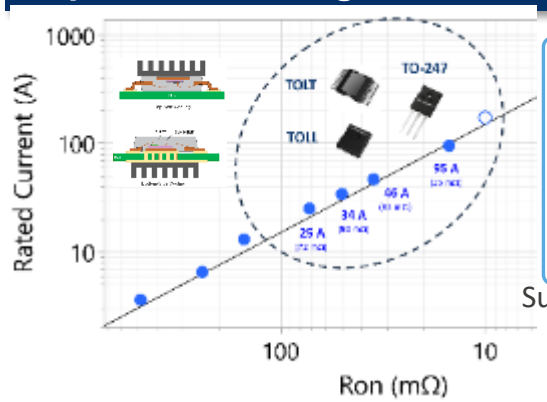


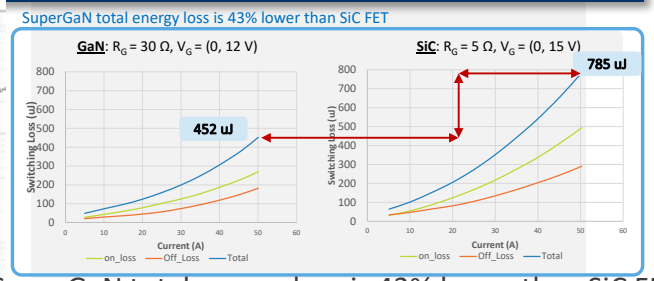
Future

Single-stage AC/DC



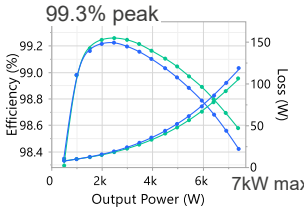
Why We Win: High Power Packages, Reliable, d-mode GaN for superior switching & low loss–easy to drive, higher efficiency





SuperGaN total energy loss is 43% lower than SiC FET

350 billion+ field hours



Superior switching performance in both hard-switching and soft-switching.

Renesas GaN superior option for high power vs. Si, SiC, Other GaN

AC/DC Bridgeless Totem-pole PFC - Selector

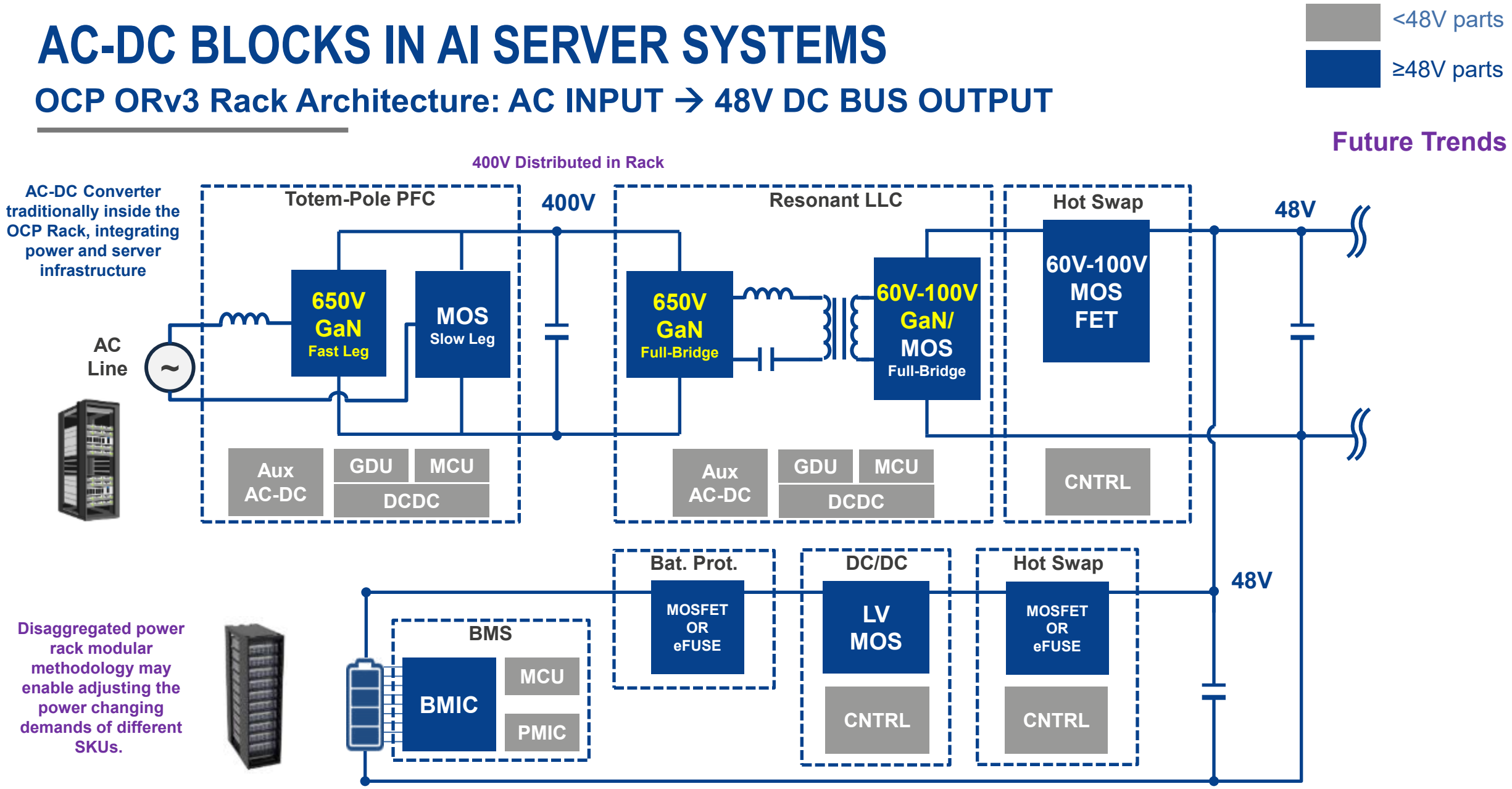
Power Level	$R_{DS(ON)}$ (mΩ)	Package	Device
> 1.0 kW to 1.5 kW	70	TO-220	TP65H070G4PS
	70	TOLL	TP65H070G4QS
> 1.5 kW to 2.0 kW	70	TO-220	TP65H070G4PS
	70	TO-263	TP65H050G4BS
	50	TOLL	TP65H050G4QS
		TO-247	TP65H050G4WS
> 2.5 kW to 3 kW	50	TO-247	TP65H050G4WS
		TOLL	TP65H050G4QS
> 3.3 kW to 4.5 kW	35	TO-247	TP65H035G4WS
		TOLL	TP65H035G4QS
> 5 kW	15	TO-247	TP65H015G5WS

DC to DC (Half Bridge - LLC) - Selector

Power Level	$R_{DS(ON)}$ (mΩ)	Package	Device
> 1.0 kW to 1.5 kW	70	TO-220	TP65H070G4PS
	50	TOLL	TP65H050G4QS
> 1.5 kW to 3.0 kW	50	TO-247	TP65H050G4WS
	35	TOLL	TP65H035G4QS
> 3.0 kW to 3.5 kW	35	TO-247	TP65H035G4WS
> 3.5 kW	35	TO-247	TP65H035G4WS
	15		TP65H015G5WS

AC-DC BLOCKS IN AI SERVER SYSTEMS

OCP ORv3 Rack Architecture: AC INPUT → 48V DC BUS OUTPUT



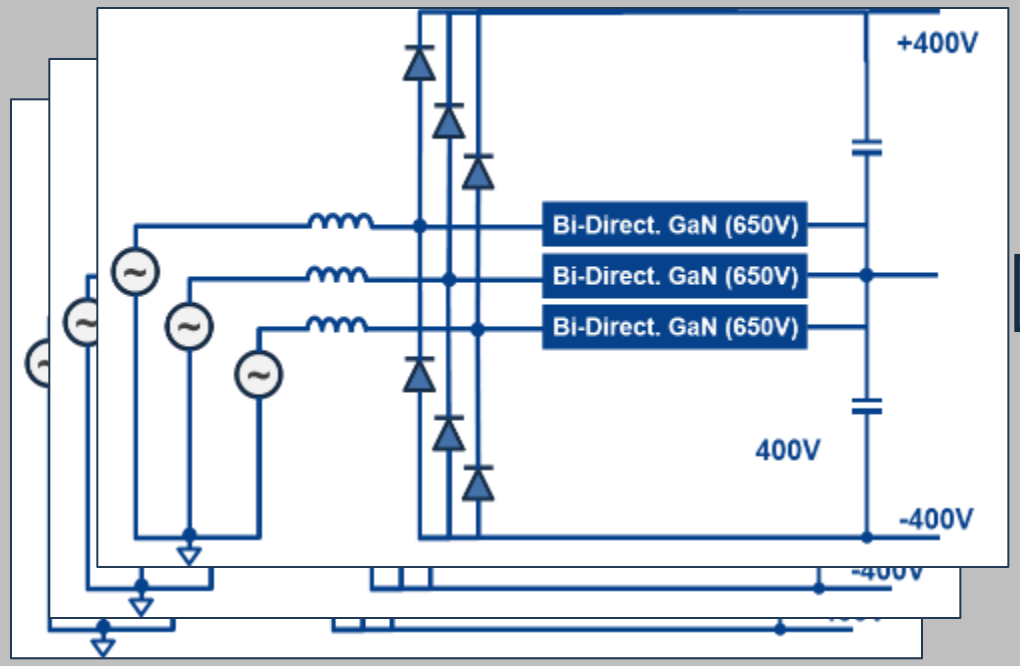
MOVING TO HV BUS IN DATACENTER

Disaggregated Rack Architecture: ±400V → 48V (or lower) DC BUS OUTPUT

<48V parts

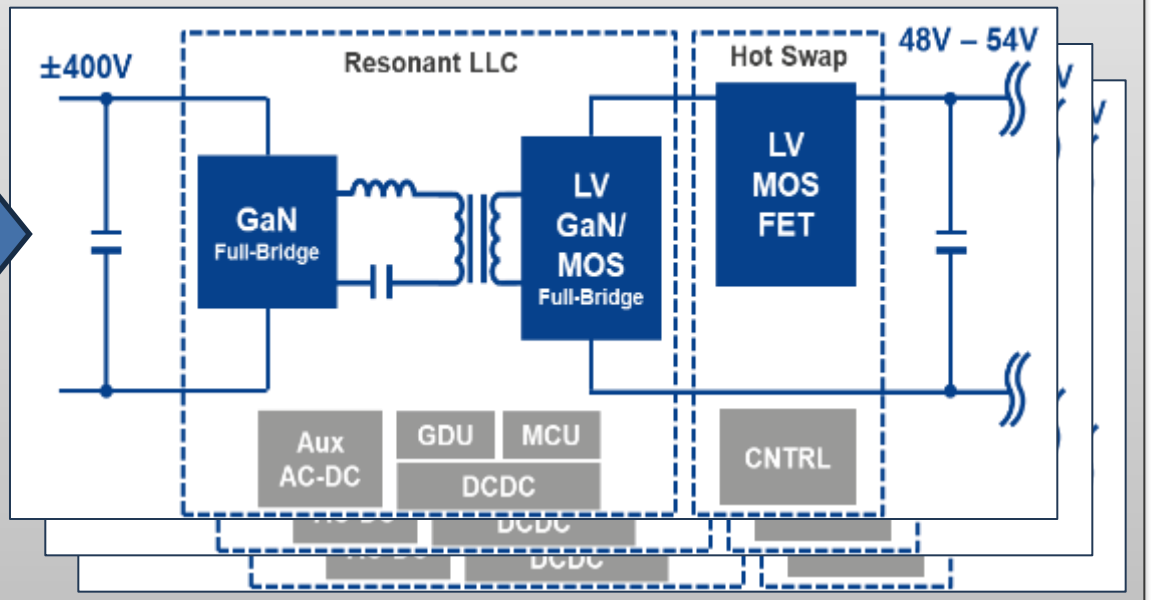
GaN/MOSFET

AC/DC Side Rack



±400V

±400V Distributed in Rack

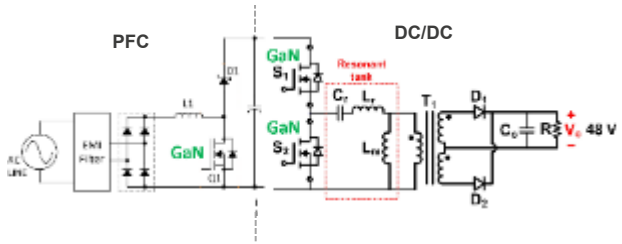


MID-POWER MARKET: 300W-1KW

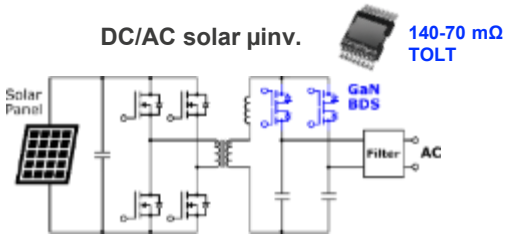
Applications: Our GaN Improves Efficiency, Smaller Size

Electric 2/3 Wheelers | Gaming Computing | Lighting | Servers | Solar – Microinverter

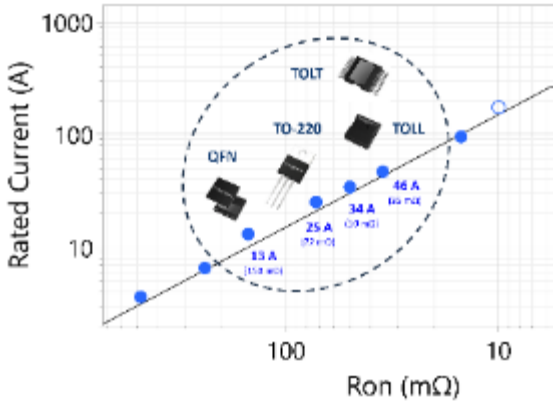
AC/DC Converter



DC/AC solar μinv.

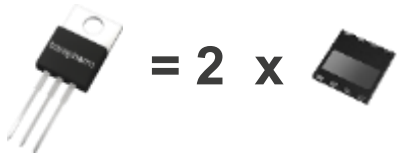


Why We Win: Superior Thermals/ Packages (eg. Below)



Enable standard and surface mount packages

Superior thermal and dynamic switching with lower loss than competitors



= 2 x

Renesas SuperGaN TO-220

e-mode

Approaching / exceeding silicon's affordability

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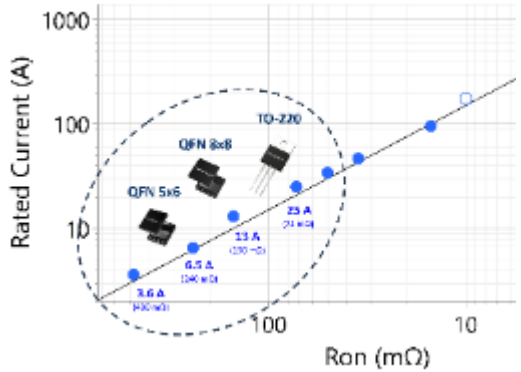
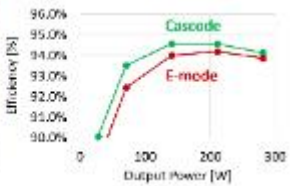
LOW-POWER MARKET: 30W-300W
DISCRETE + INTEGRATED SOLUTIONS

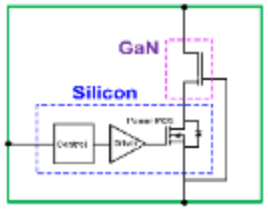
Why We Win: Easy to Use, Higher Performance





Commercial Adapter ~15% improvement in losses by "dropping-in" Renesas Super GaN vs. e-mode GaN

- Higher efficiency (compact, cooler)
- Easy to Interface & Simpler BOM: Compatible with standard drivers and controllers. System in package will be available (SIP).
- Proven qualification and multi-billion hours in field at various power levels

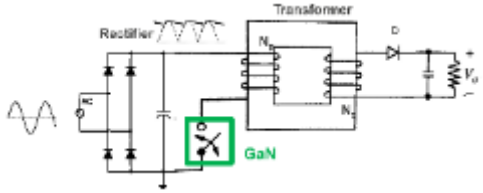


System in Package (SIP)
Controller, driver, power GaN

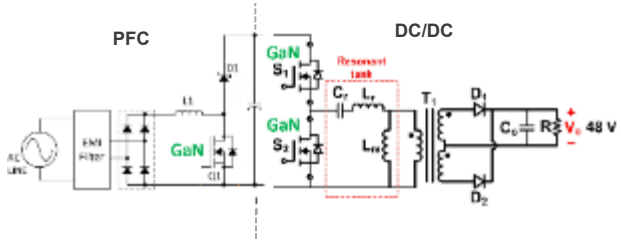
Applications: GaN Improves Efficiency, Smaller Size

AC-DC Adapters & Fast Chargers | Game Consoles | Laptops | LCD TVs

AC/DC Flyback, ZVS



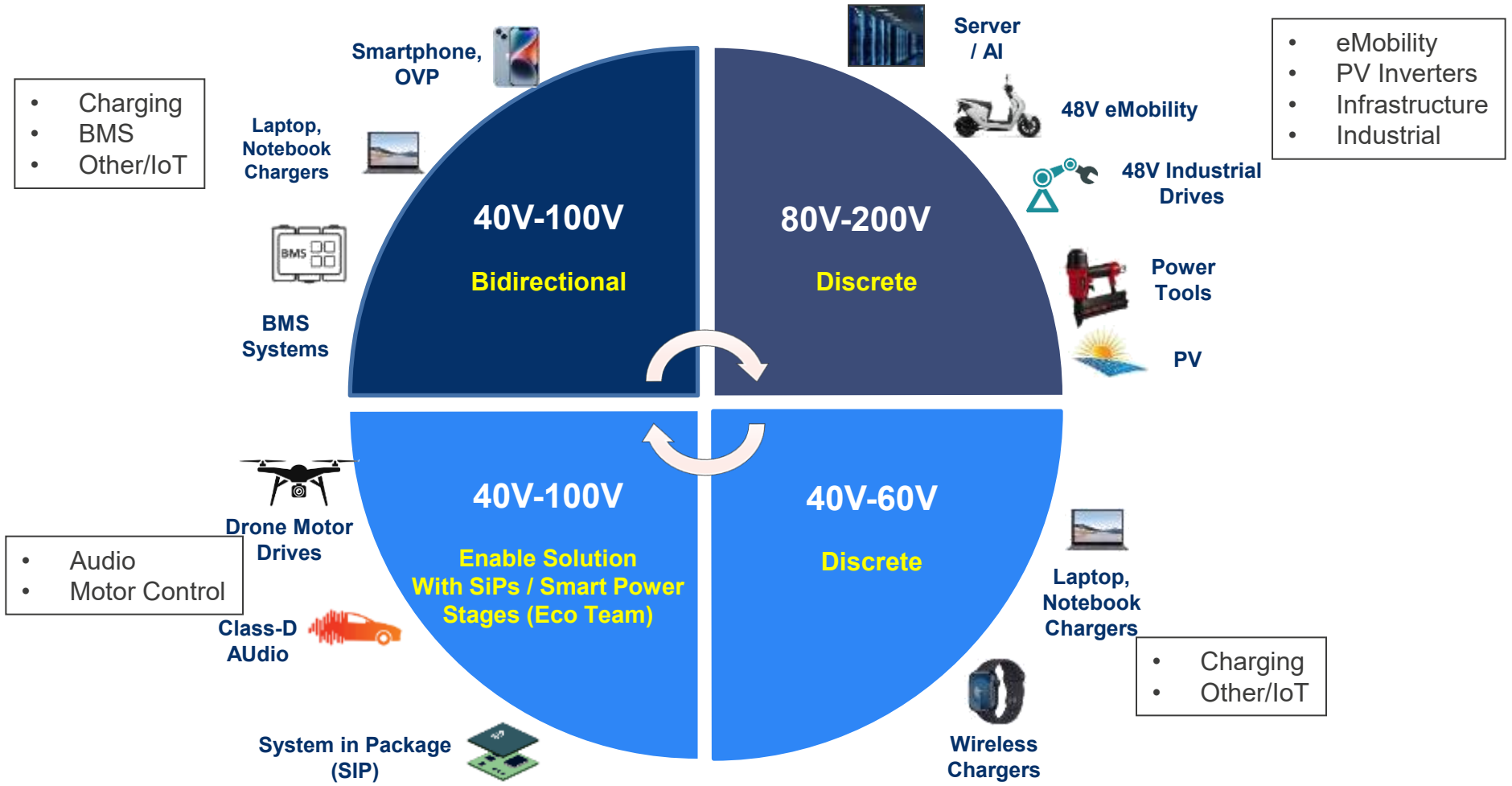
AC/DC Converter



2. LOW VOLTAGE GAN

40V-200V GAN

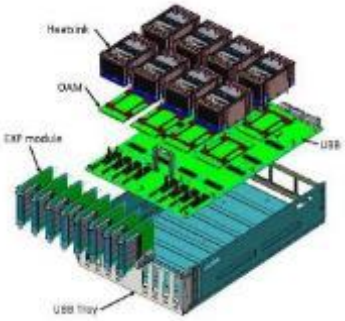
LV GAN: E-MODE 40V-200V
NEW BUSINESS DEVELOPMENT – FOCUS ON CHARGER, BMS AND 48V INFRA



LV GaN development with focus on Laptop charger, BMS and 48V infrastructure architecture

48V SYSTEM ARCHITECTURE

OCP ORv3 Rack Architecture: 1-ph AC INPUT → 48V DC BUS OUTPUT



IBC trending to 8:1 HSC Converter

48V

IBC – Hybrid Sw. Cap. 4:1

Driver | LV GaN/ MOS 3x | LV GaN/ MOS 3x | Driver

1kW

CNTRL

Driver | LV GaN/ MOS 3x | LV GaN/ MOS 3x | Driver

1kW

Multiple IBCs will operate in parallel to deliver up to 3kW

Intermediate Bus
12V → ~5V

12V

Future Trends

Digital Multi-Ph V_{CORE}

DMP CNTR

SPS

SPS

IVR

<1V

SPS Tech.
28V → 16V

PoL w/ PMBus

PoL (analog)

GPU up to 3kW

GPU/ CPU

Power level increasing from 500W VR Mainstream Server CPU to 2kW GPU

<48V parts

≥48V parts

THANK YOU