中国电源学会第二十三届学术年会
The 23rd China Power Supply Society Conference (CPSSC'2019)
2019年11月1日至4日
地点：深圳

Navitas

Let's go GaNFast™

GaN IC Enables Revolution in AC/DC Adaptor

Xiucheng Huang, Director of Application Engineer

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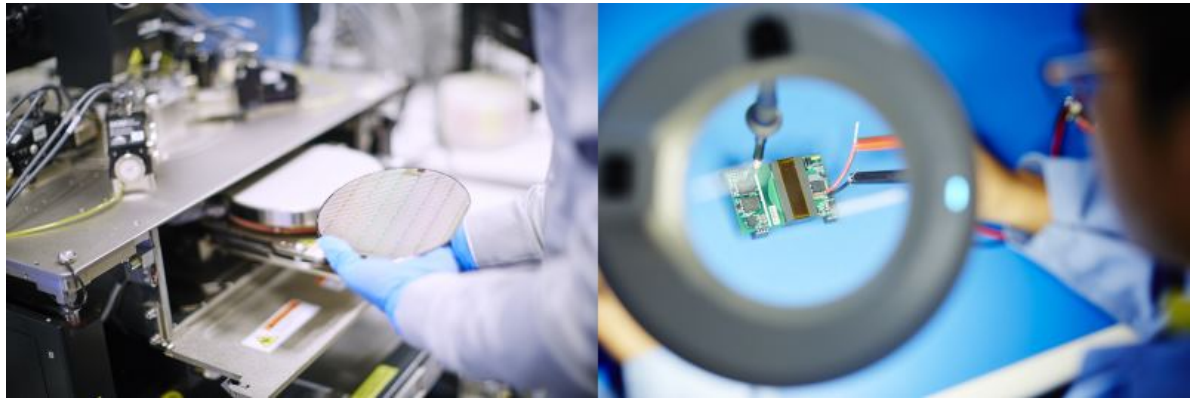
Navitas Semiconductor Inc.

GaNFast™

- World's first & only GaN power IC company
  - Production released with fast revenue ramp
- Navitas: Latin for *Energy*
  - ***Energy*** *savings*
  - *Bringing a new* ***Energy*** *to power electronics*
- Founded January 2014, HQ El Segundo, CA
- Proven management team, 75+ employees
- Tier 1 manufacturing partners
  - Wafer foundry, packaging
- Strong financial investors ($1B+ managed capital)



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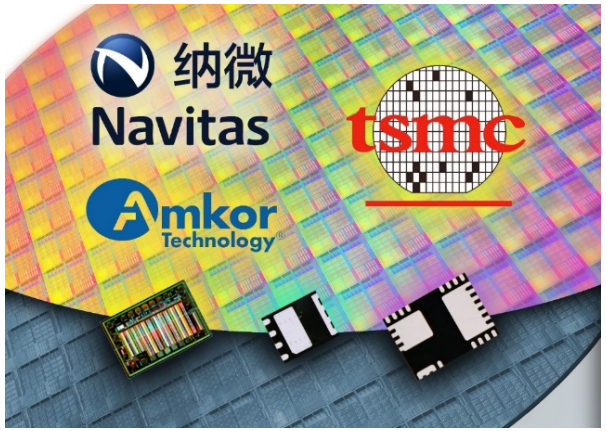
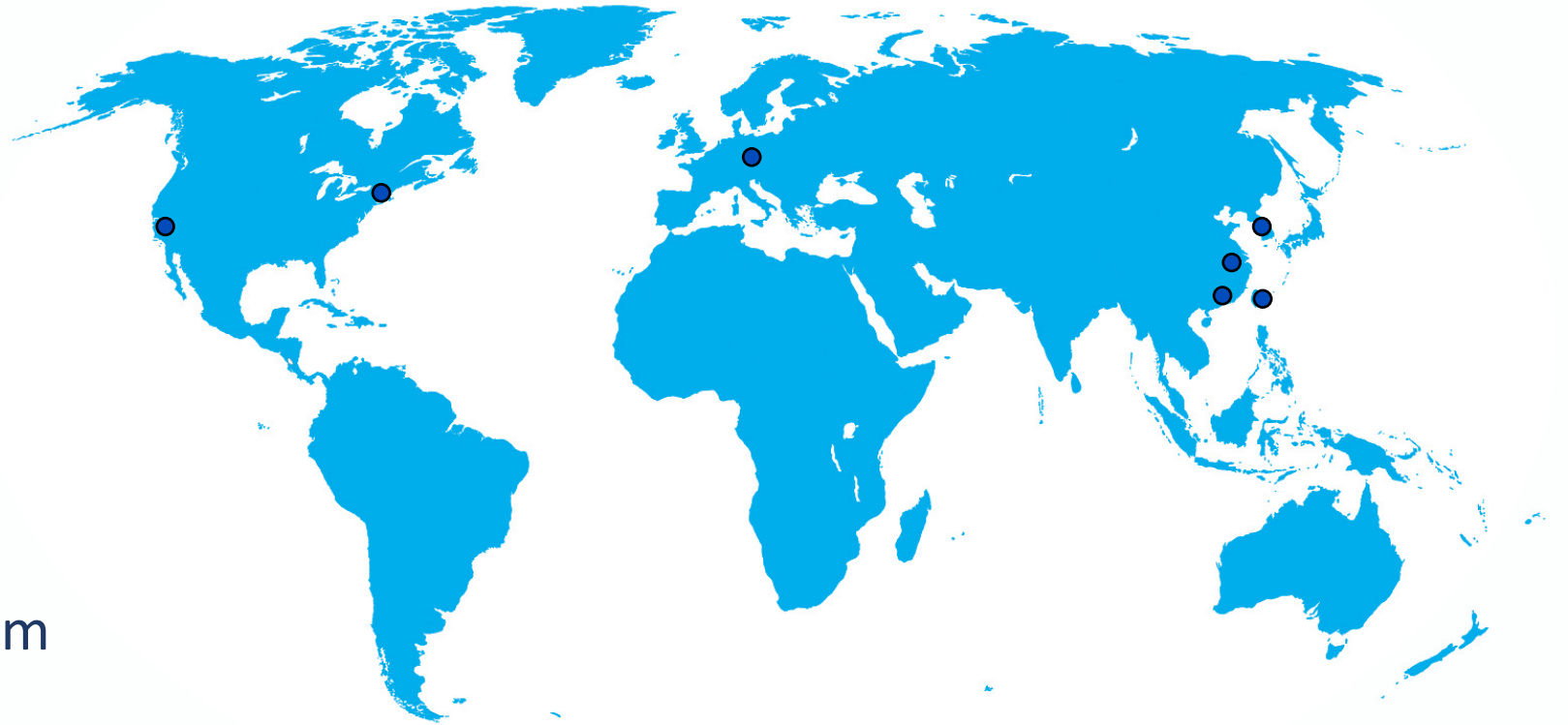
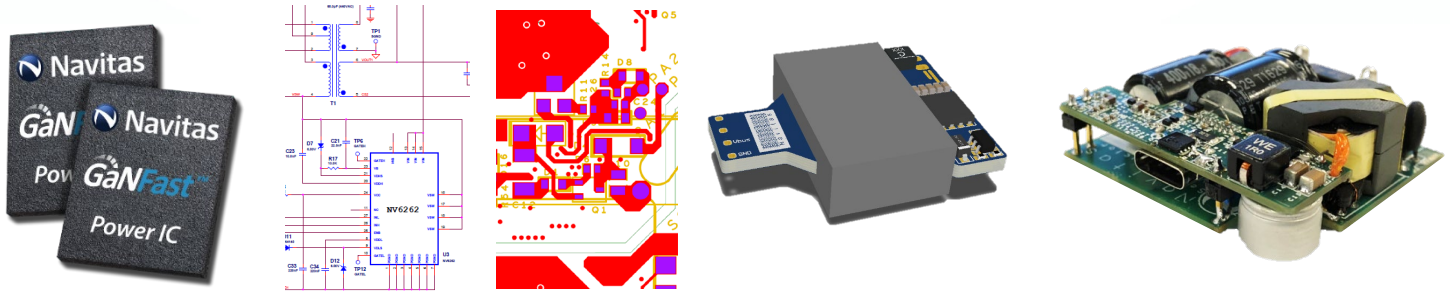


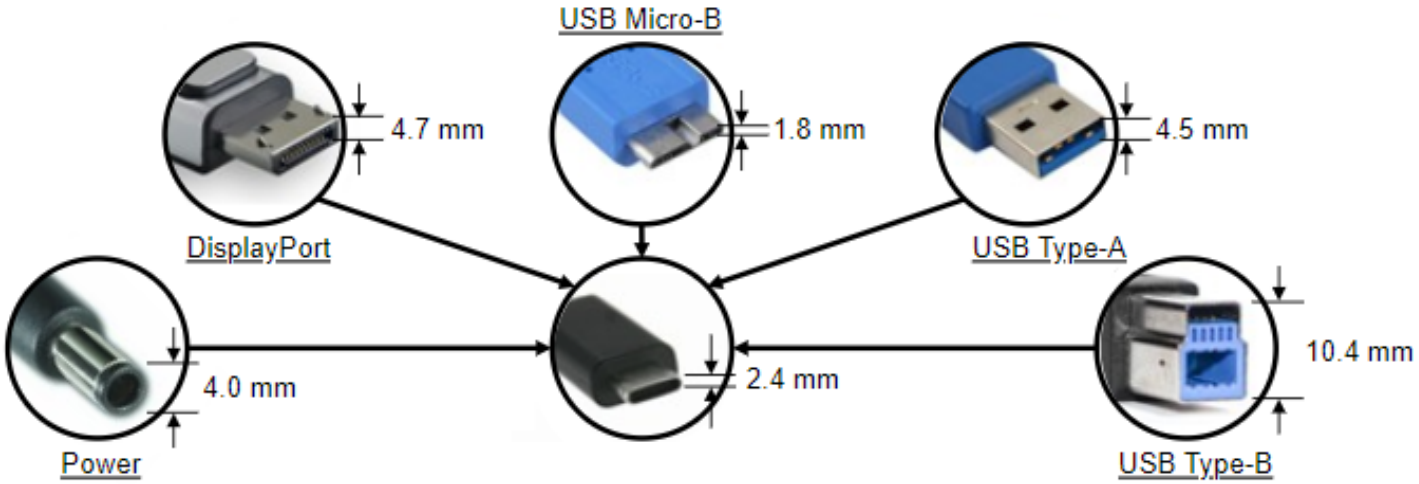
GaNFast Design Support

- Global technical support
  - Direct support
  - Partner support (VAR)
- Strong AE team
- Strong FAE team
- GaNFast Design Support Program
  - From schematic to EMI
  - Components, magnetics, PCB
  - Critical component support
  - System Reliability support





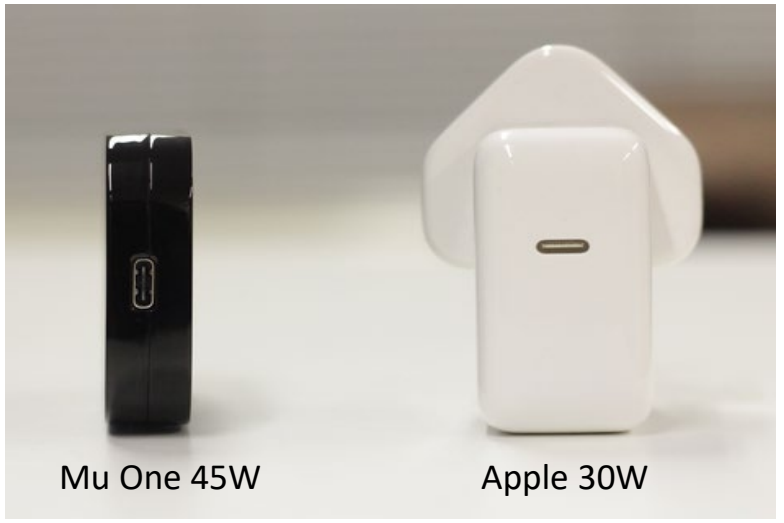
USB Type C & Power Delivery



All in one: Type C connector

One for all: PD adapter/charger

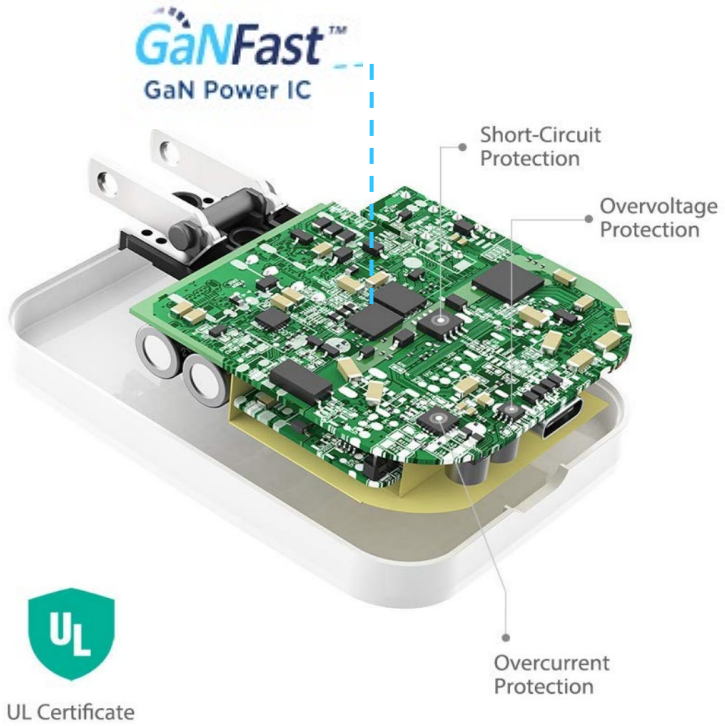
Mu One 45W PD: World Thinnest Adapter



- 5V/3A, 9V/3A, 12V/3A, 15V/3A, 20V/2.25A
- 14 mm profile
- CE, UL, etc.
- Available now on www.amazon.com

Images courtesy Made-in-Mind

RAVPower 45W: Same Platform



- Available now on www.amazon.com

Images courtesy RAVPower

AUKEY 24W, 27W, 30W

- Available now on www.amazon.com

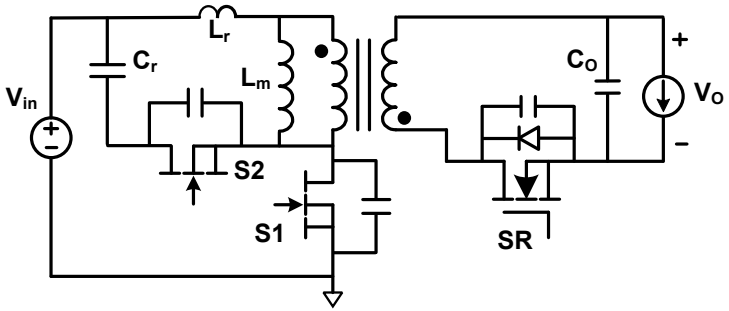
Images courtesy AUKEY

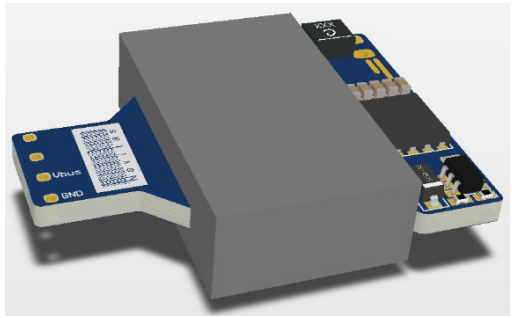
How Can We Make It?

A. Select the right semiconductor devices

B. Select the right topology, frequency and control

C. Select the right magnetics and design properly

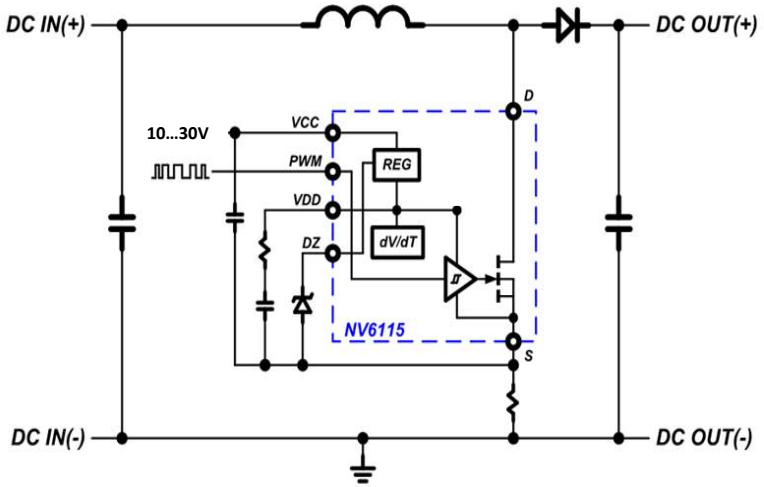




World First GaN Power IC

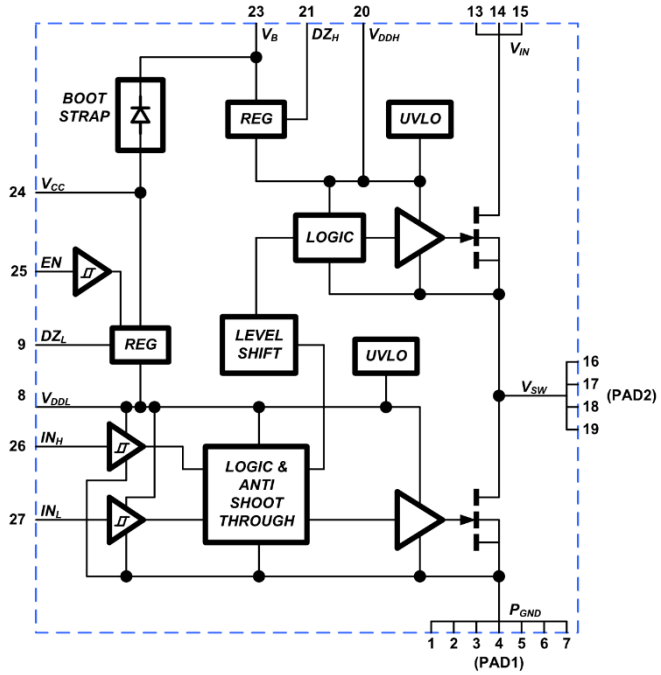
GaNFast™

Single GaN IC

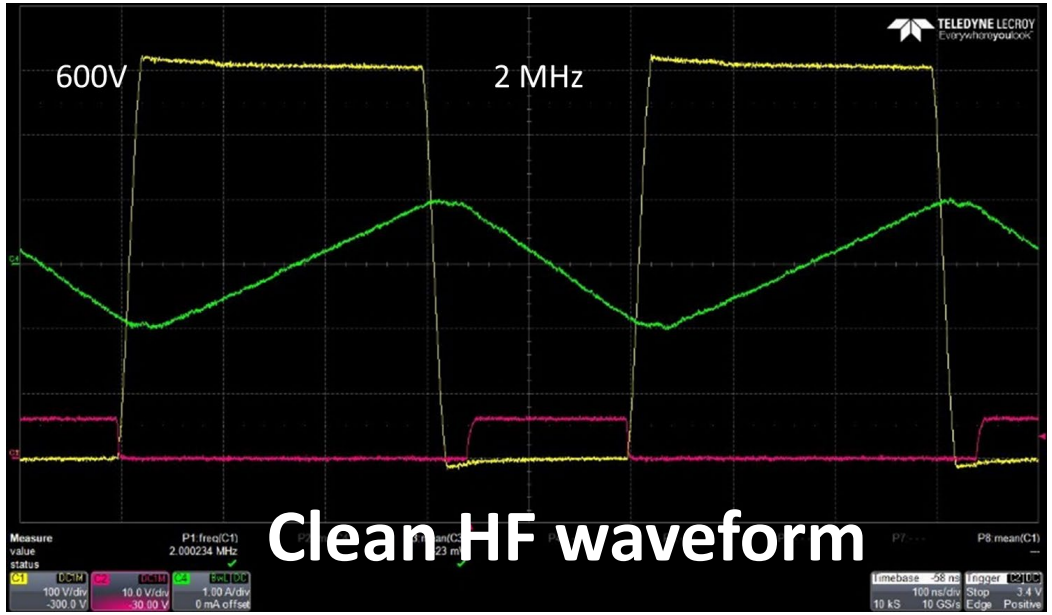


- Monolithic integration, 650V
  - GaN FET +GaN Driver + GaN Logic

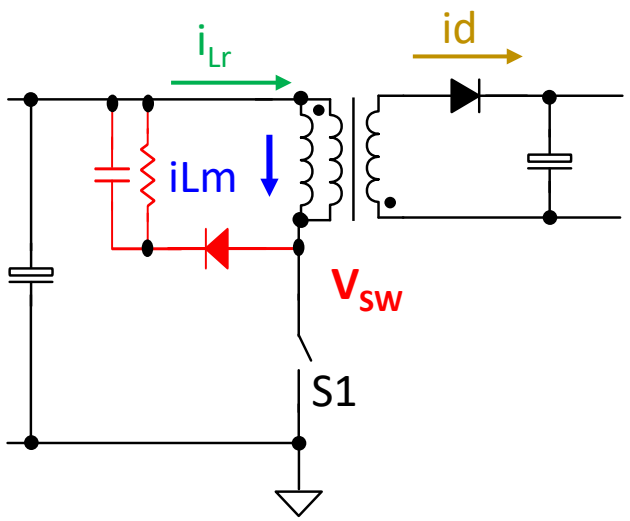
Half-bridge GaN IC

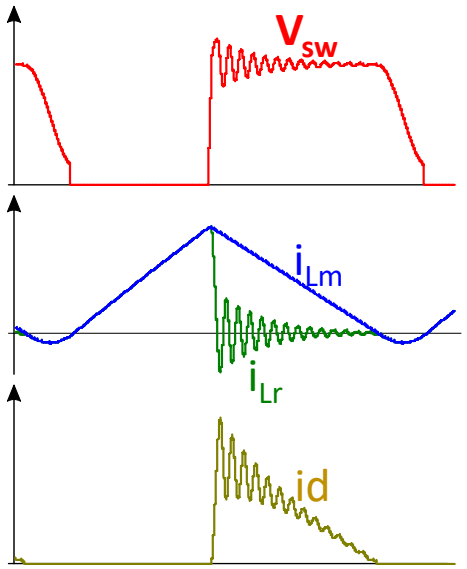


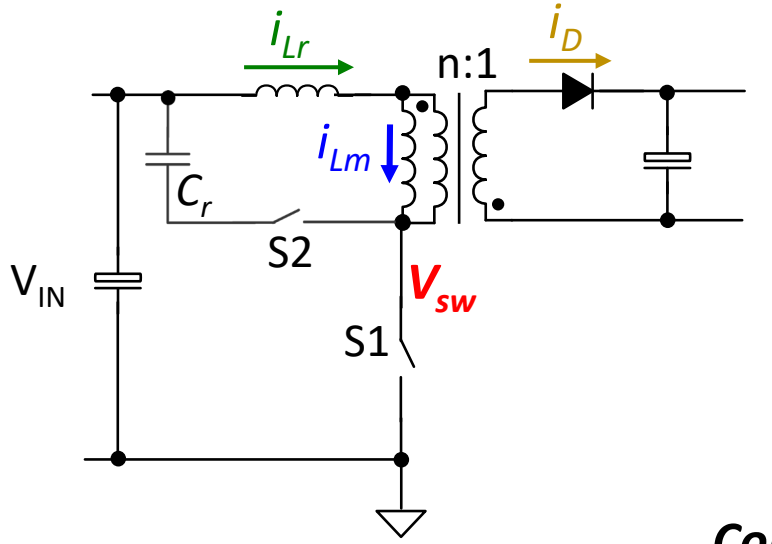
- Monolithic integration, 650V
  - 2x GaN FETs
  - 2x GaN drivers
  - GaN Logic (level-shift, bootstrap, shoot-through)

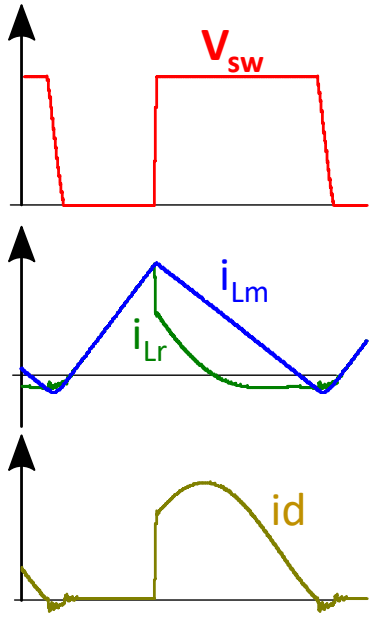


Active Clamp Flyback with Soft-Switching





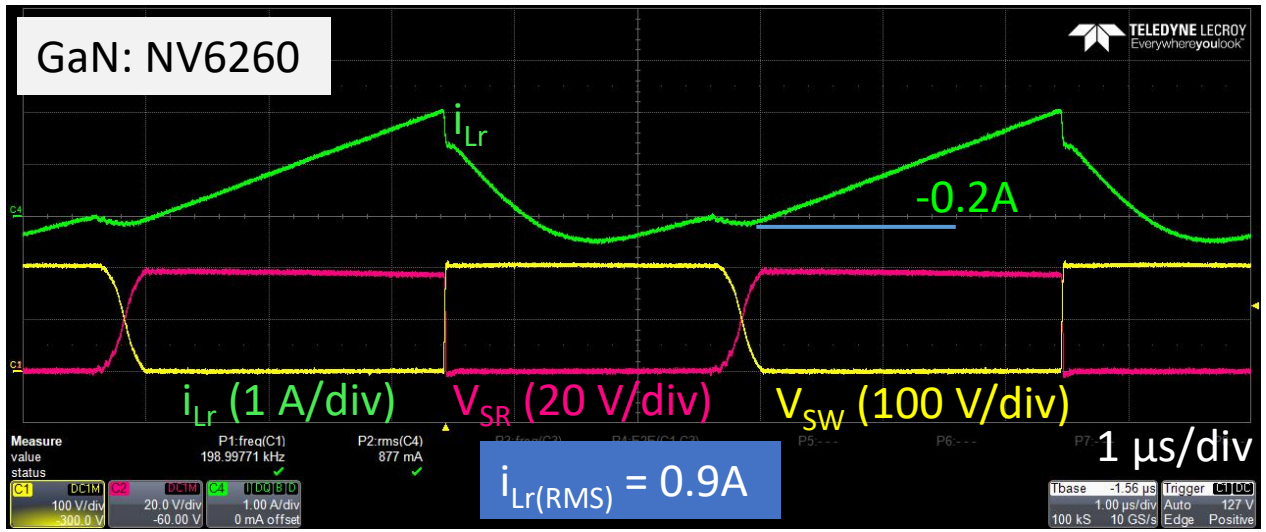




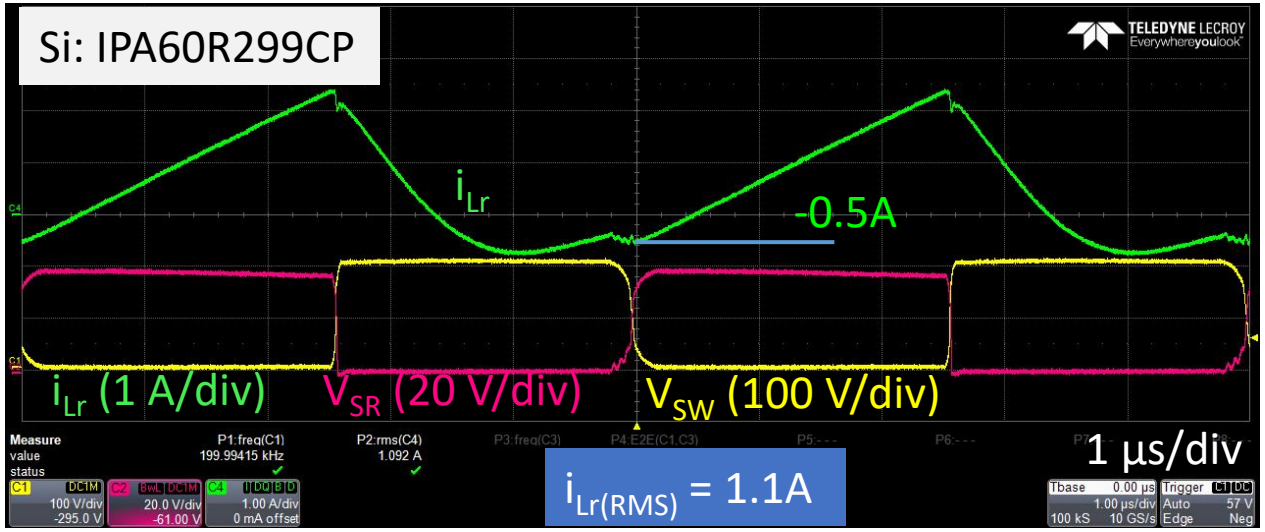
Commercial IC Available !!

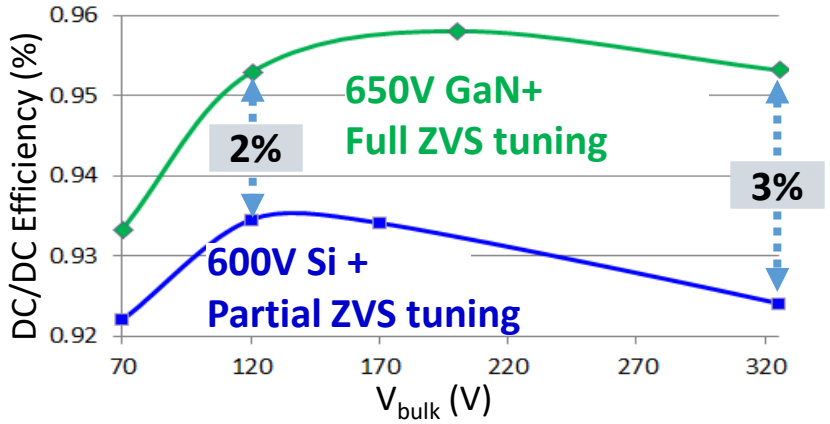
GaN vs. Si in ACF

2%-3% Higher Efficiency with Low C_{OSS}, Q_G, Q_{rr} , E_{off}



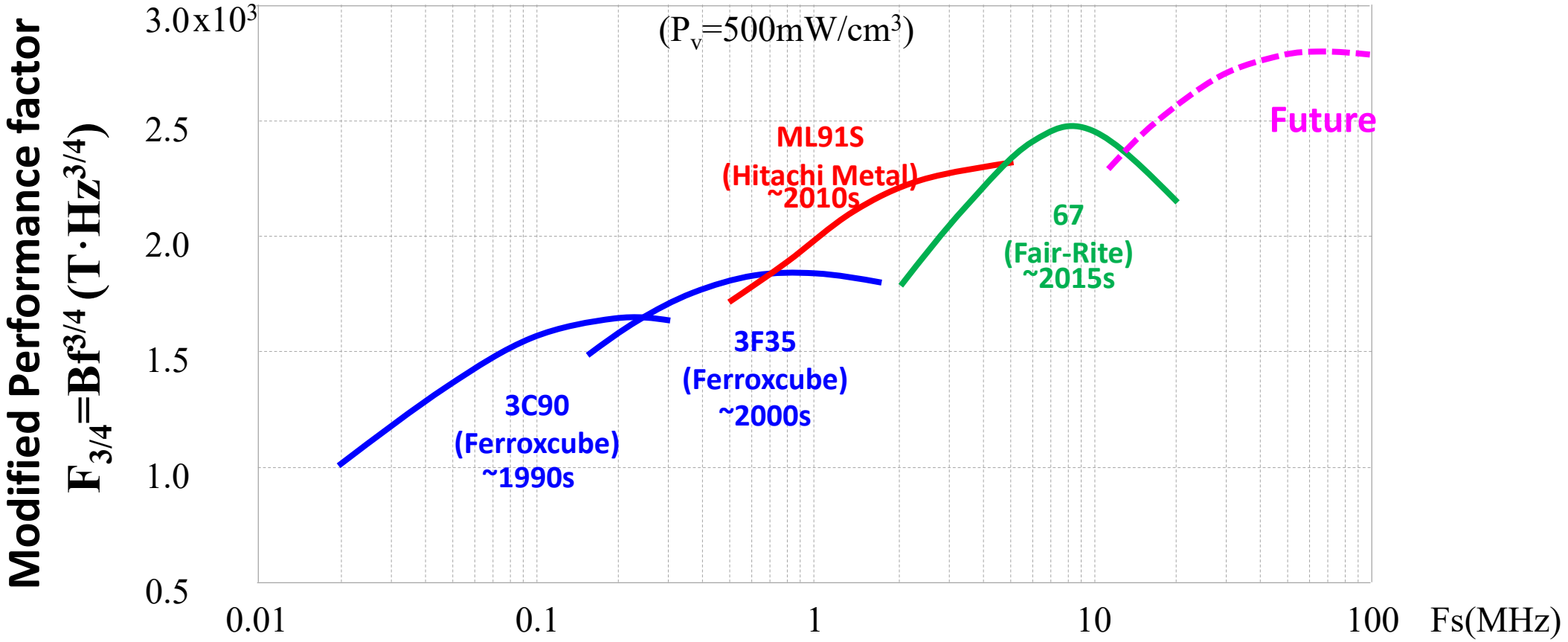
	IPA60R299CP	NV6260 (per FET)
Voltage Rating (V)	650	650
$R_{DS(ON)}$	270	40% ↓ 160
C_o(tr) (pF)	120	60% ↓ 50
Q_g (nC)	22	90% ↓ 2.5
Q_{rr} (nC)	3900	0





Courtesy of Texas Instruments (ACF w/ pri resonance)

Advanced Magnetic Material



Y. Han, G. Cheung, A. Li, C. R. Sullivan and D. J. Perreault, "Evaluation of Magnetic Materials for Very High Frequency Power Applications," in *IEEE Transactions on Power Electronics*, vol. 27, no. 1, pp. 425-435, Jan. 2012.

A. J. Hanson, J. A. Belk, S. Lim, C. R. Sullivan and D. J. Perreault, "Measurements and Performance Factor Comparisons of Magnetic Materials at High Frequency," in *IEEE Transactions on Power Electronics*, vol. 31, no. 11, pp. 7909-7925, Nov. 2016.

Magnetic: Bulky / Expensive → Small / Cheap

GaNFast™

Vol (mm³)

12000

10000

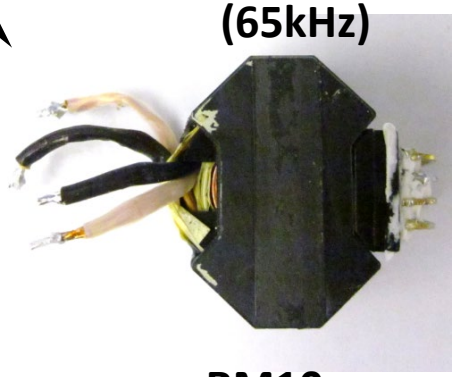
8000

6000

4000

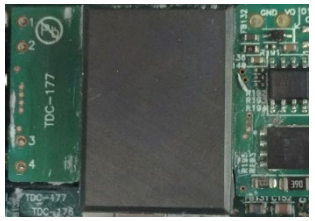
2000

Chrome book
(65kHz)



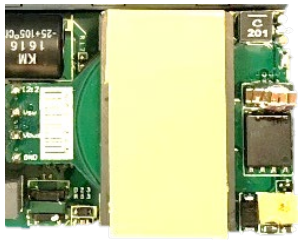
RM10

Innergie
(200kHz)



~ EQ25

Navitas
(400kHz)



ER25

CPES
(1MHz)

ER23

100

200

300

1000

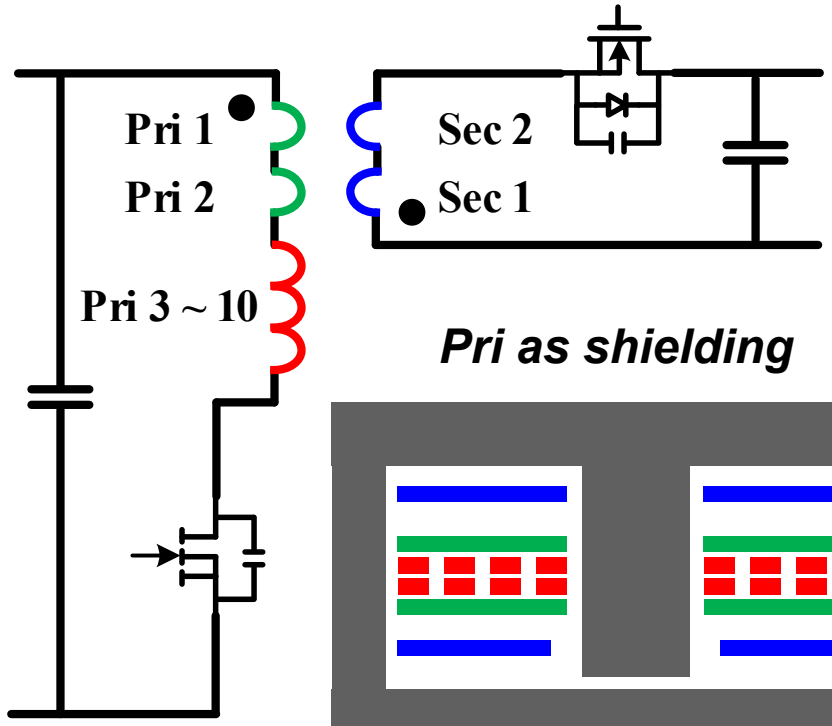
Freq (kHz)

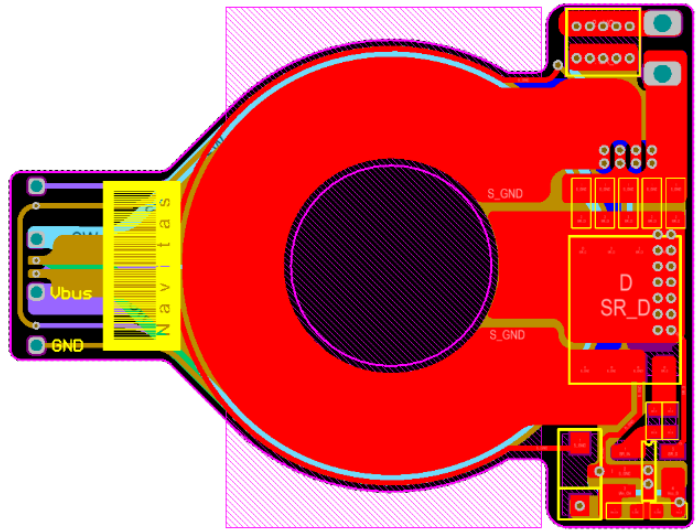
65kHz → 200kHz 2.5x size reduction

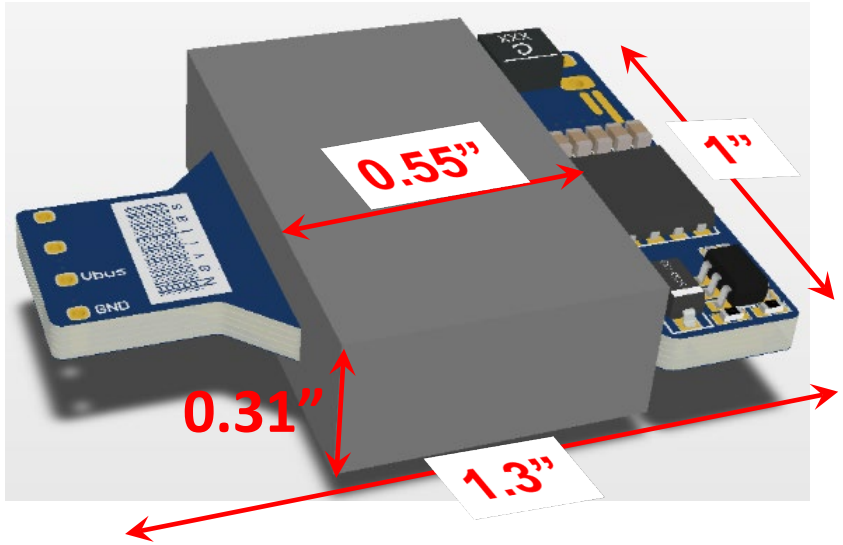
200kHz → 400kHz 1.5x size reduction

400kHz → 1MHz 1.5x size reduction

Planar Magnetics→ Manufacturability

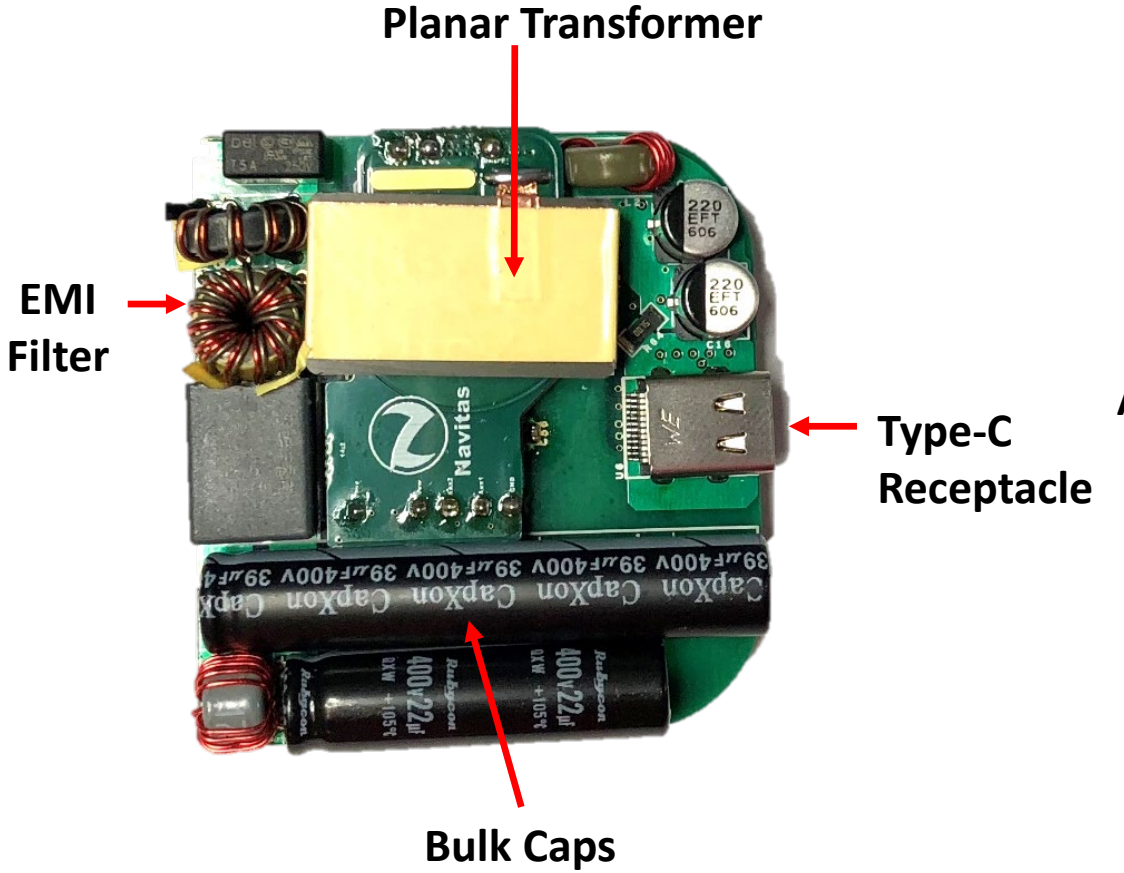


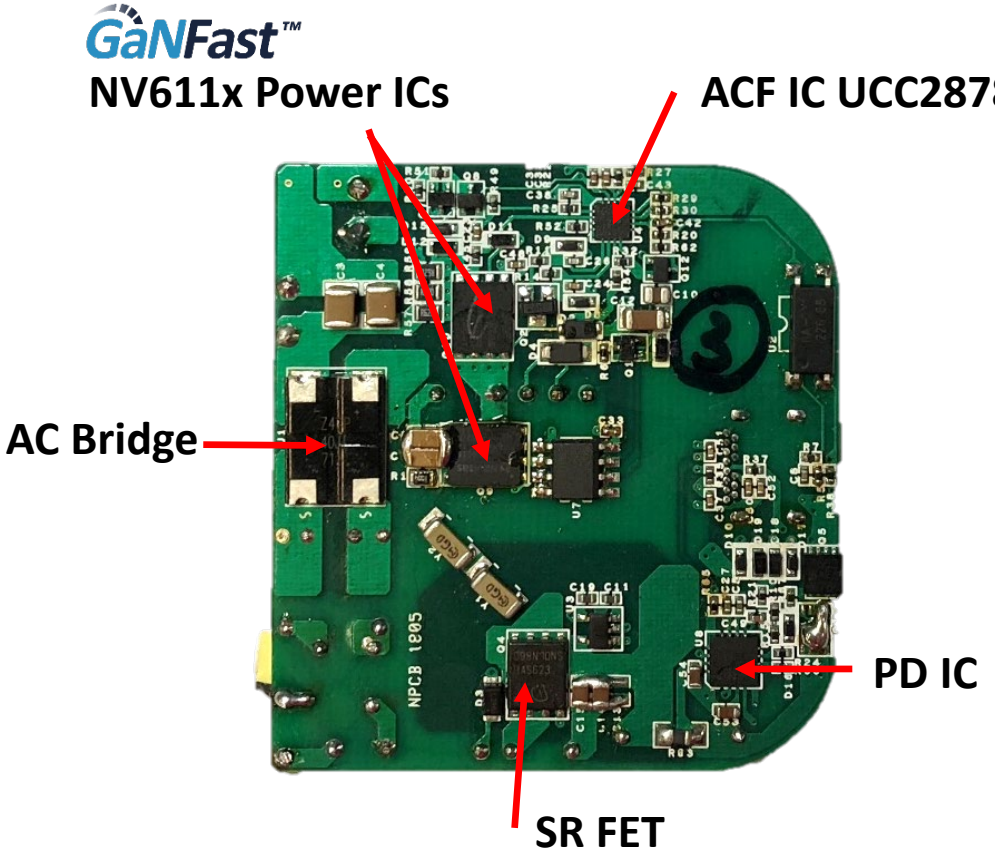




- SR on sec winding, minimized L_k & R_{ac}
- Shielding integrated as pri winding
- Safety rule compliance

45 W in 11 mm = HF Planar ACF





- Size : 29 cc (41 cc with case)
- Density : 1.7 W/cc (27 W/in^3), 1.1 W/cc (18 W/in^3) cased

Cool Operation

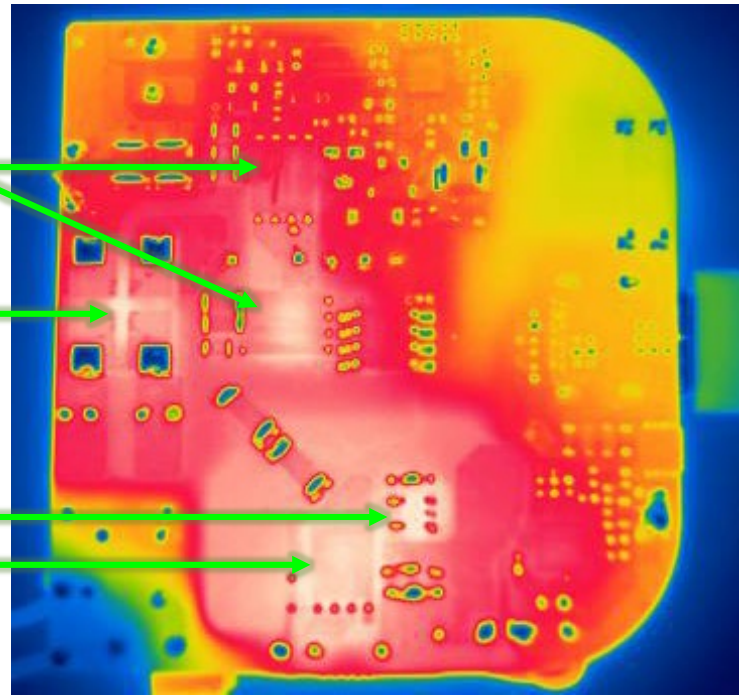
Top

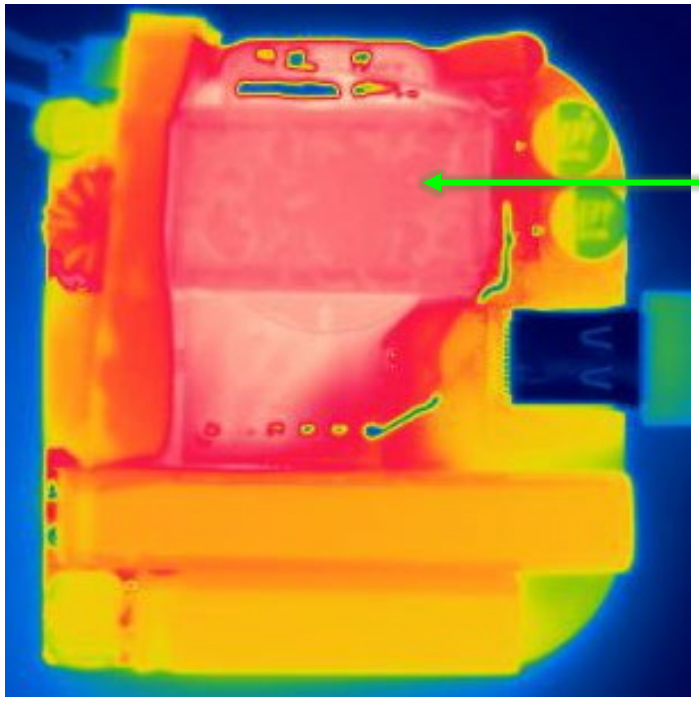
Bottom

GaNFast
Power IC 75°C, 80°C

AC Bridge 80°C

SR IC 85°C
SR FET 85°C



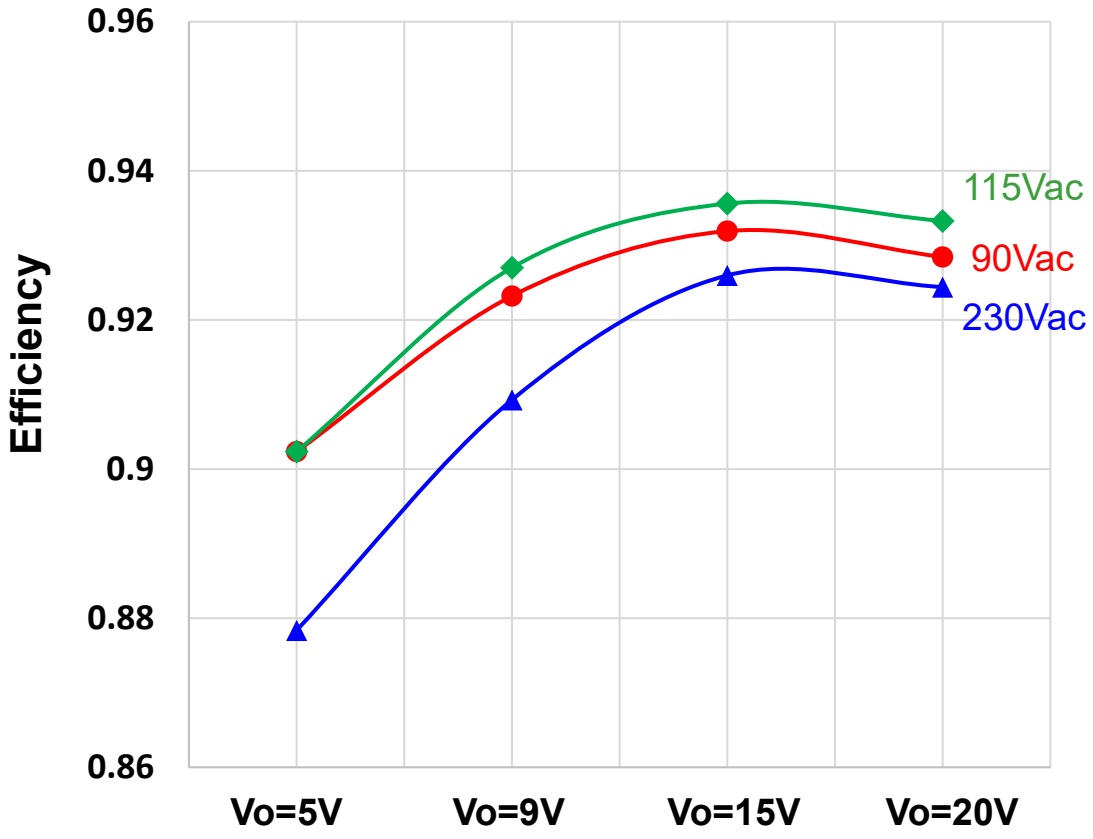


Transformer 80°C

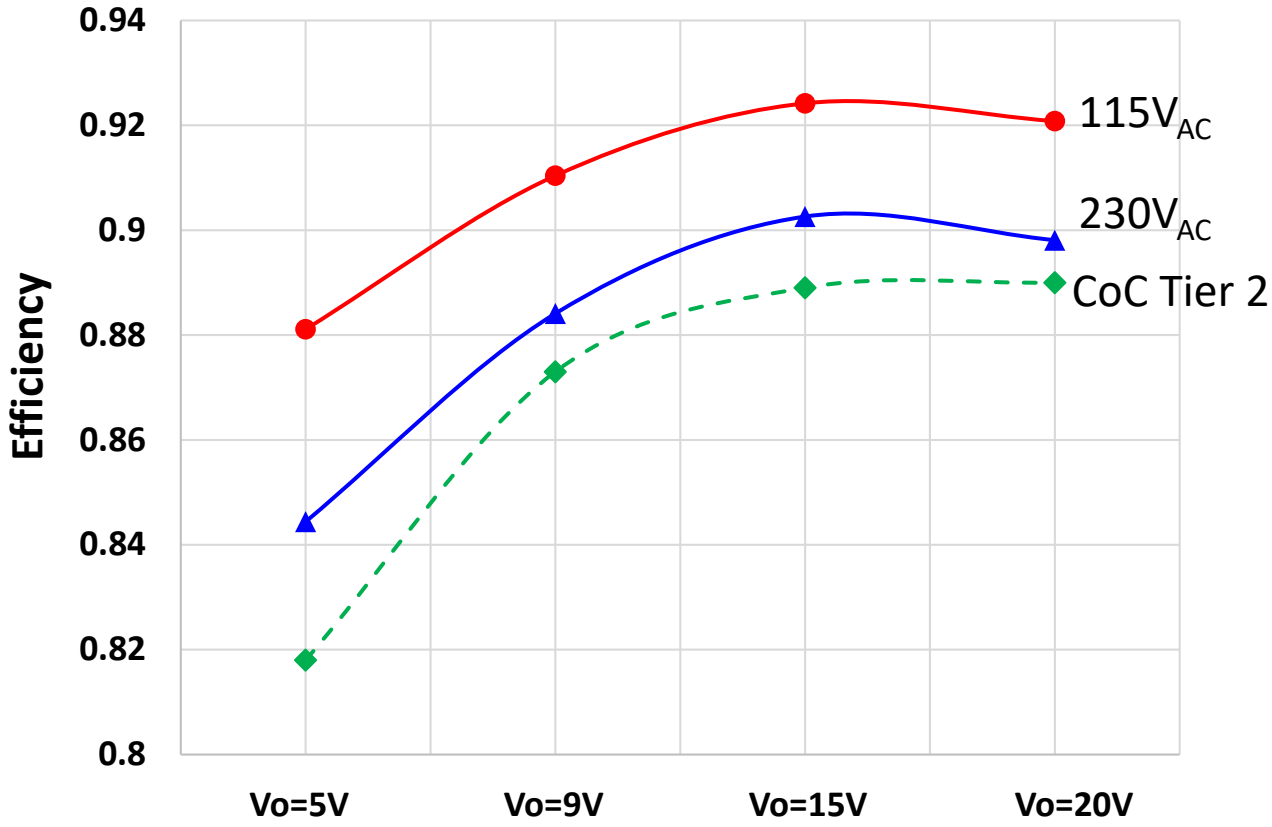
90 V_{AC}, 45 W, 25 °C, uncased, no airflow,
no thermal compound / heatsinking

High Efficiency

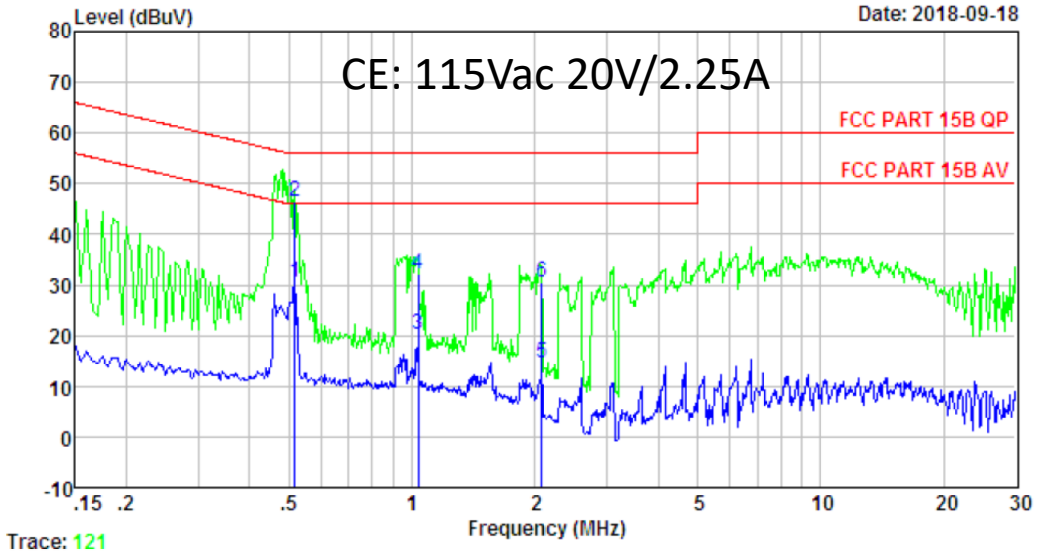
Full Load Efficiency

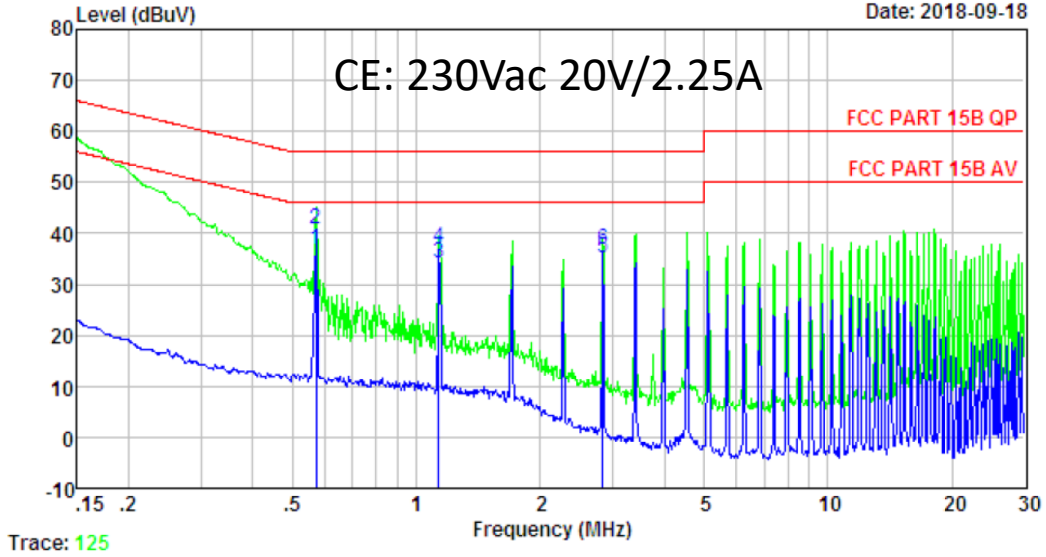


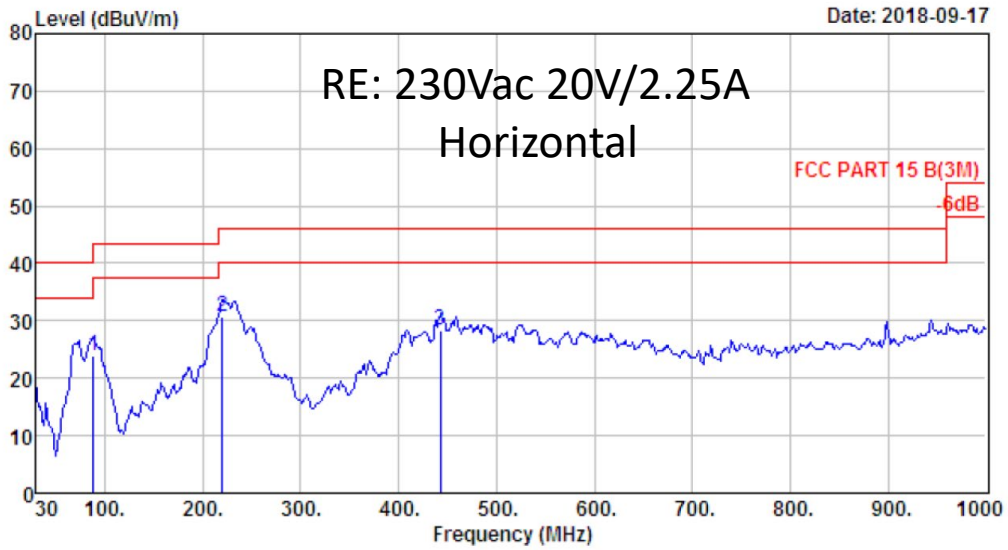
4-Point Average Efficiency

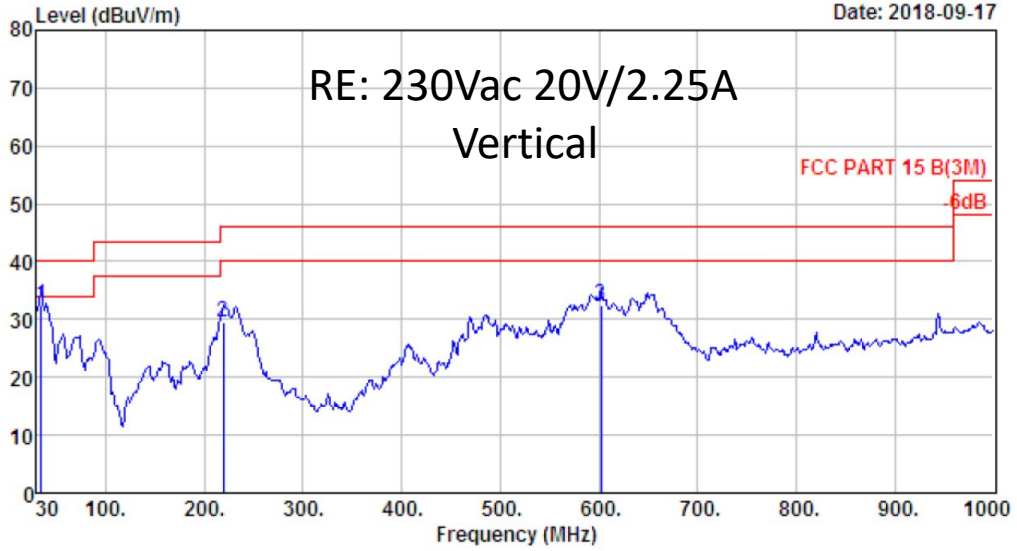


Quiet EMI (Conducted, Radiated)

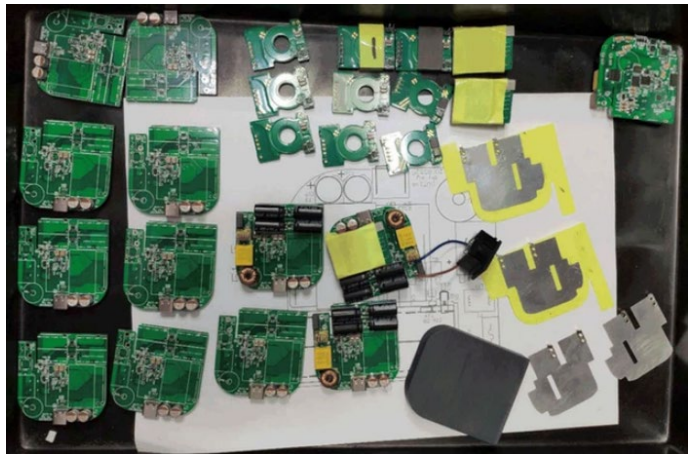








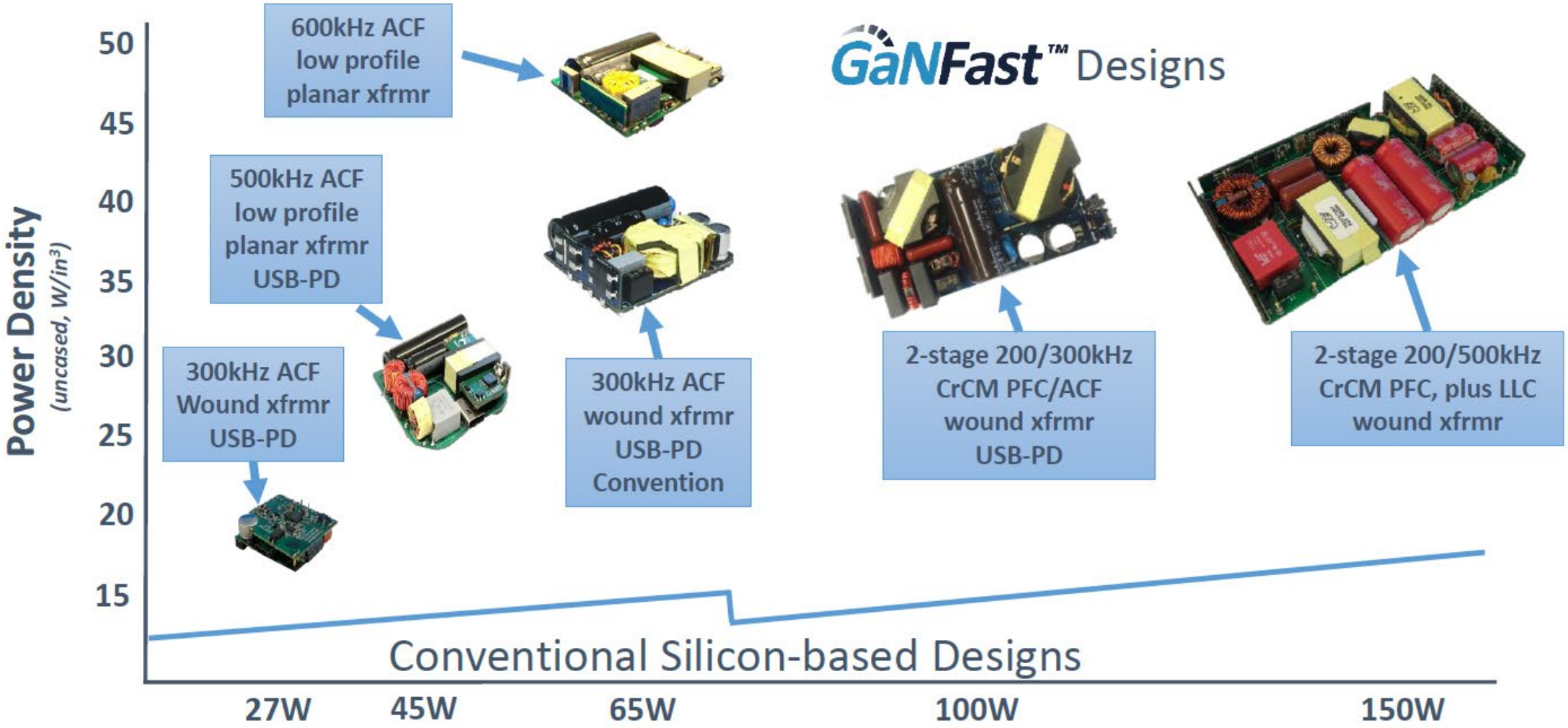
Mu One: From Prototype to Mass Production



- Thanks to Matt Judkins, CEO of Made-in-Mind (Mu)
- Available via www.amazon.com and airport stores in NOW!

Images courtesy Made-in-Mind

The New World of Fast Charging



Information available on www.navitassemi.com

Let's go GaNFast™