纳微GaNsafe™ 驱动超高性能AI服务器电源设计

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报告大纲

- **高功率密度高效率服务器电源是当前数据中心的发展要求**
  - 数据中心服务器电源的钛金效率要求
  - 数据中心服务器电源的超高功率密度要求
- **高性能服务器电源技术方案讨论**
  - 目前传统硅方案的可行性分析
  - 基于第三代半导体(SiC/GaN)方案的可行性分析
- **纳微GaNsafe™助力实现高功率密度高效率服务器电源**
- **纳微CRPS185 3200W 钛金Plus服务器电源方案**
  - 纳微CRPS185 3200W 钛金Plus服务器电源方案
  - 300kHz GaN based 3200W LLC Vs 150kHz Si based 3200W LLC
- **纳微CRPS185 4500W 97% AI 服务器电源方案**

数据中心驱动科技发展

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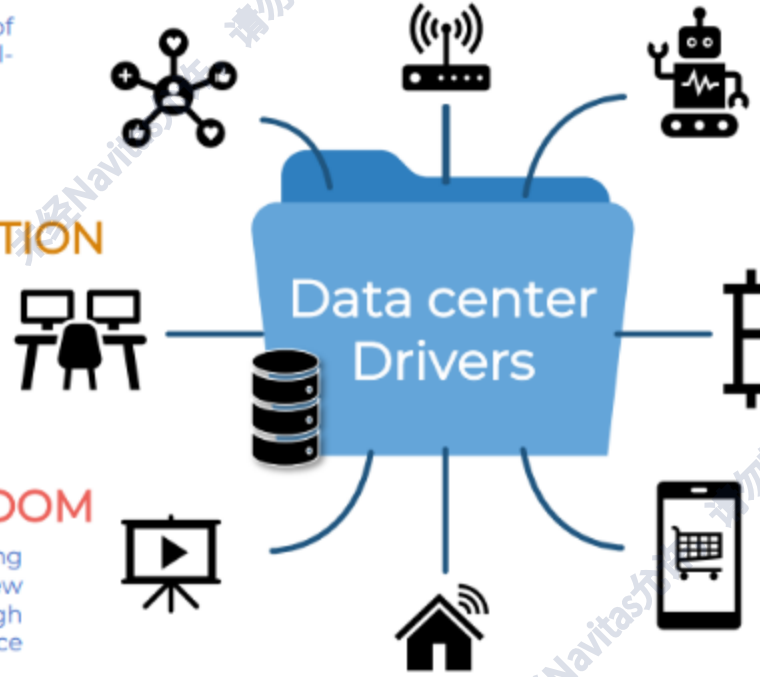
DATA CENTERS DRIVERS

AI is like the new "EV tech" for the software industry.

8- 5G & IOT
Vast amounts of data from more connected devices necessitate data centers for processing, storing, and efficiently managing this data.

7-SOCIAL MEDIA INFLUENCE
Data centers manage enormous amounts of user-generated content, interactions, and real-time data analysis.

1- AI REVOLUTION
AI and machine learning require more powerful processors (CPU, GPU) and more storage servers to analyze the big data.



6- HOME OFFICE REVOLUTION
Remote work and virtual collaboration tools increased the reliance on data centers for hosting video conferencing, team meetings, and remote solutions.

2- CRYPTO MINING
Numerous large data centers have been built only for crypto mining. Powerful computing resources are needed to process complex cryptographic algorithms and validate transactions in blockchain networks.

5- VIDEO STREAMING BOOM
The popularity of video streaming platforms has increased, requiring new data centers capable of delivering high bandwidth and low-latency performance to a global audience.

3- E-COMMERCE EXPANSION
US e-commerce sales exceeded $1.1 trillion in 2023, up 10% year over year. To support this growth worldwide, data center infrastructure must handle online retail operations, manage customer data, and ensure seamless shopping experiences.

4- DIGITAL TRANSFORMATION:
Administrative transactions in the private and public sectors are switching to online platforms and are targeting paperless, saving time and reducing carbon footprint by reducing mobility. The more we digitize, the more digital infrastructure we need.

传统数据中心供电架构及其耗电量

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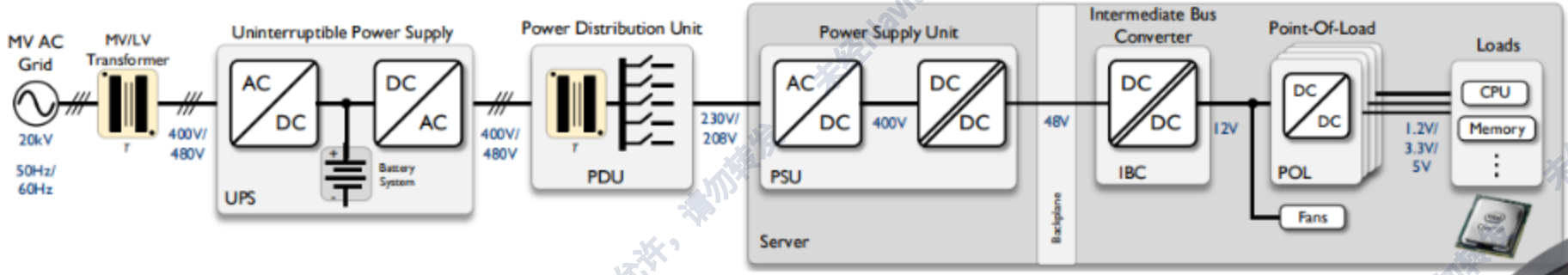
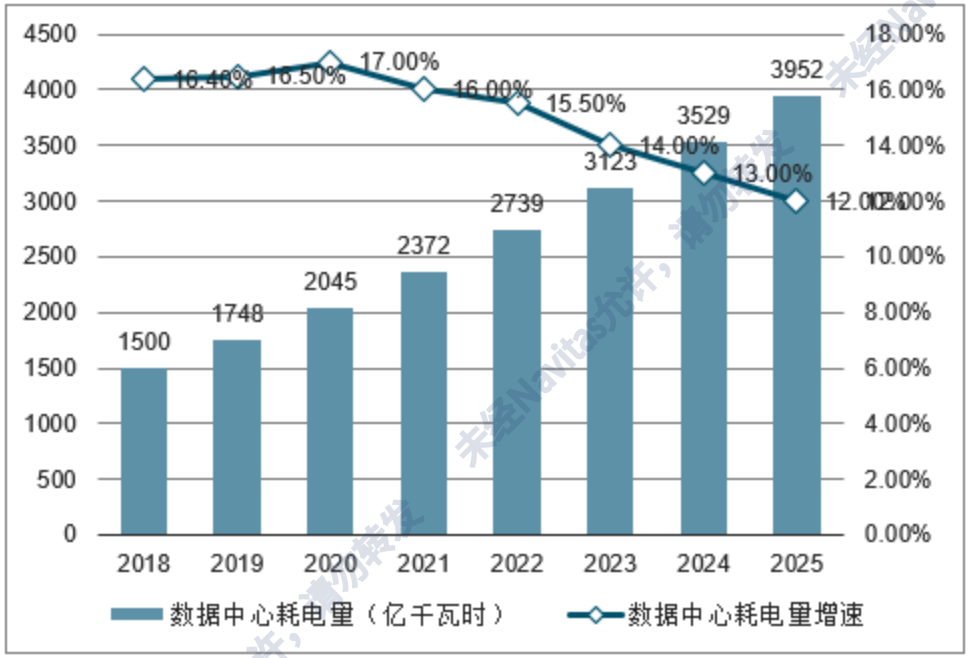
Traditional Configuration: AC UPS





数据中心每年耗电量占全年总社会用电量**3%**以上，相当于1.5个**三峡**年发电量

1%的效率提升，每年可节省约1个**新安江水电站**发电量

高效率服务器电源是当前数据中心的发展要求

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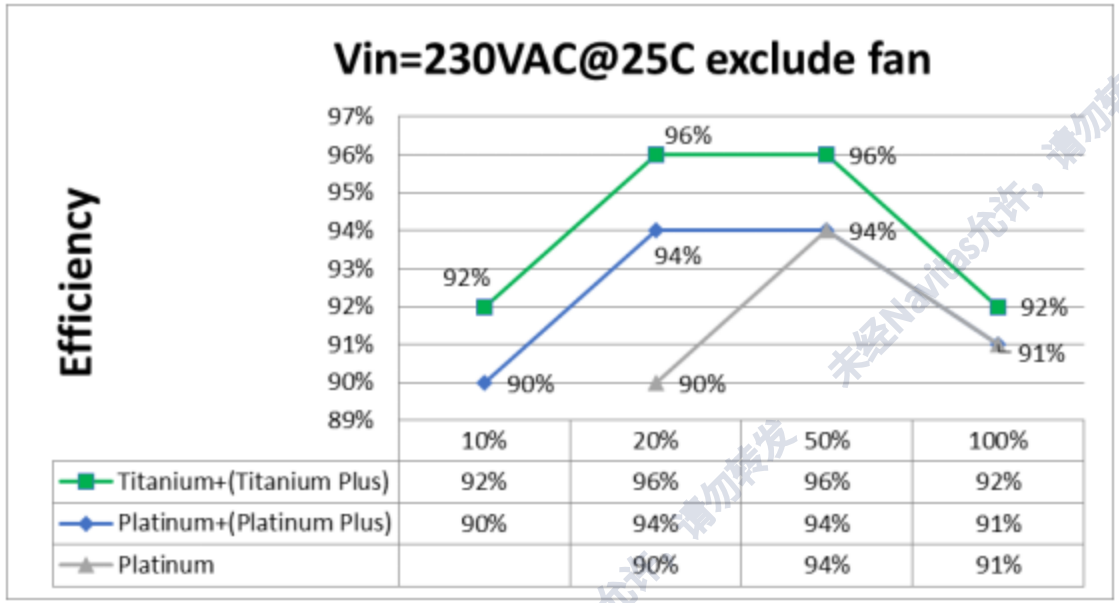
80 PLUS 计划是由美国能源署出台，Ecos Consulting 负责执行的一项自愿认证计划，旨在促进计算机和服务器 电源的能源高效利用。

80PLUS 认证	负载	白牌	铜牌	银牌	金牌	铂金	钛金
		80 PLUS	80 PLUS Bronze	80 PLUS Silver	80 PLUS Gold	80 PLUS Platinum	80 PLUS Titanium
230V Internal Redundant	10%	N/A	---	---	---	---	90%
	20%		81%	85%	88%	90%	94%
	50%		85%	89%	92%	94%	96%
	100%		81%	85%	88%	91%	91%

		Efficiency				Power Factor				80 Plus	
Requirement	Output/Load	10%	20%	50%	100%	10%	20%	50%	100%	230 V non-redundant	230 V redundant
Lot 9 (March 2020)	Multi	—	88%	92%	88%	—	—	0.90	—	Gold	Gold
	Single	—	90%	94%	91%	—	—	0.95	—	Platinum*	Platinum
Lot 9 (Jan. 2023)	Multi	—	90%	94%	91%	—	—	0.95	—	Platinum*	Platinum
	Single	90%	94%	96%	91%	—	—	0.95	—	Titanium	Titanium

欧盟对高效数据中心电源提出了明确的计划 ErP-lot9 2023→单路输出电源2023年需要满足钛金效率要求

高效率服务器电源是当前数据中心的发展要求



3200W 服务器电源常规负载	3年可省电/每台 (Titanium+ Vs Platinum+)	3年可减排/每台 (Titanium+ Vs Platinum+)
30% load (960W)	-757kWh (￥-454)	755千克 二氧化碳 303千克标准煤

*注：节省一度电，相当于减少0.997千克二氧化碳排放，相当于减少0.4千克的标准煤使用

- 相比于铂金/铂金+ 效率，每台3200W钛金+效率电源3年可节省757度电，每台电源大约可**节省454元**成本，**减少755 kg二氧化碳**排放和**303Kg标准煤**使用
- 采用钛金/钛金+ 效率，还可以提高满载效率，这有利于thermal，寿命

高功率密度服务器电源是当前数据中心的发展要求

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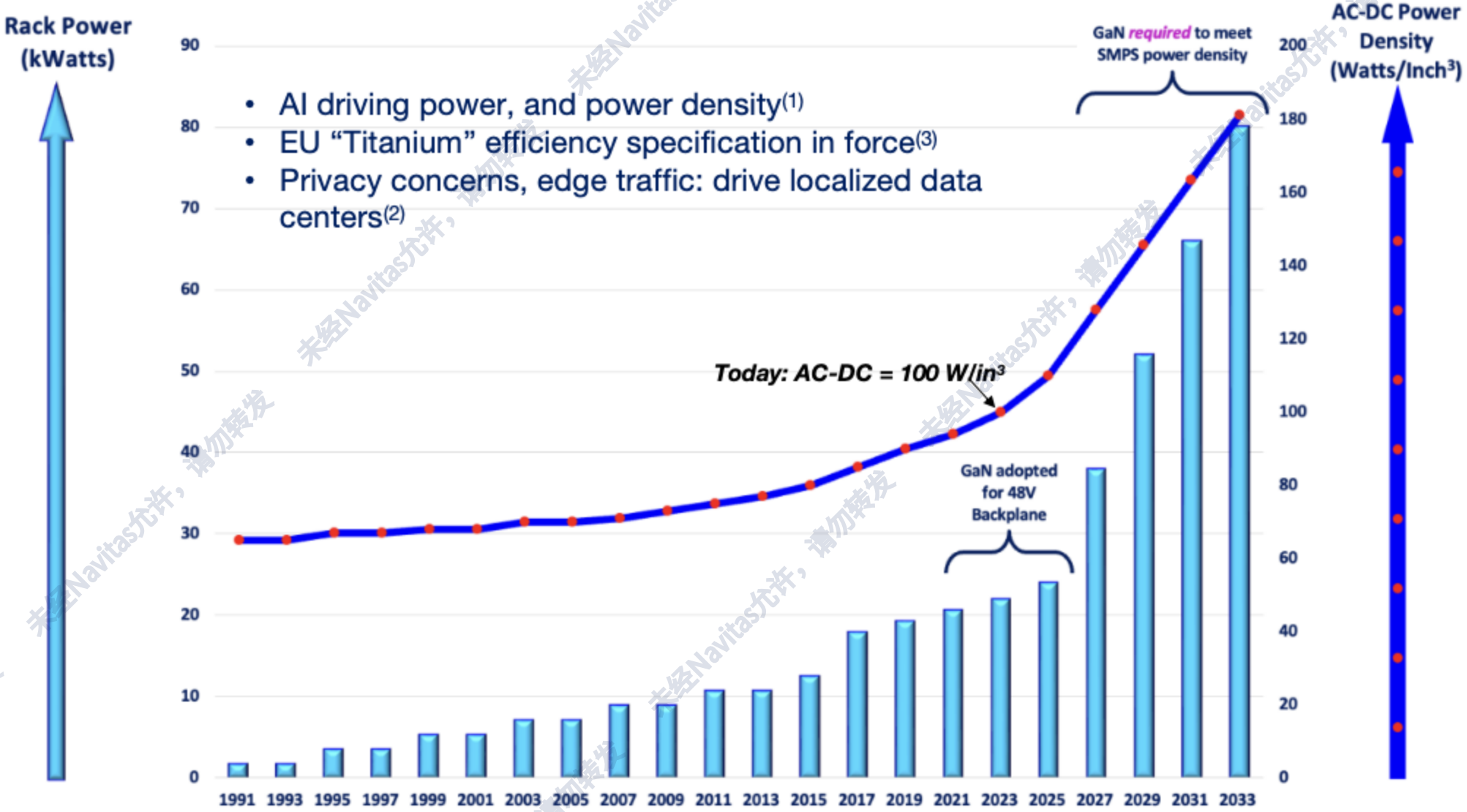
OpenAI

Bing

AUTONOMOUS VEHICLES

4000GB



1. Cerebras white paper / website
2. TD Cowen, per "AI to drive data center investments", LightReading.com, 4-26-23
3. European Union 'Directive 2009/125/EC, 2019 Annex', power supplies must be >96% efficiency peak, as of 1-1-23

高功率密度服务器电源是当前数据中心的发展要求

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英伟达 GPU					
	NVIDIA P100	NVIDIA V100	NVIDIA A100	NVIDIA H100	NVIDIA GH200
GPU功耗	300W	350W	400W	700W	1000W
AI服务器电源					
	CRPS185 2000W~2400W PD: 61~74W/inch^3	CRPS185 2.6kW/2.7kW PD: 83W/inch^3	CRPS185 3.2kW PD: 98W/inch^3	CRPS185 4.5kW ? PD: >138W/inch^3	

- 越来越强大的GPU在AI服务器的应用，加速了AI服务器电源的功率和功率密度演进和发展

CRPS185 3200W钛金服务器电源技术方案讨论

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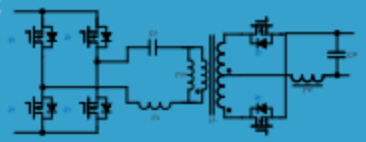
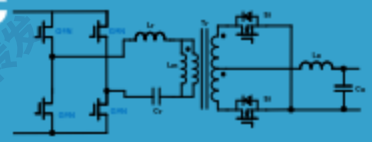
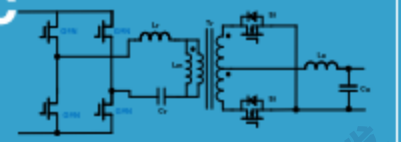
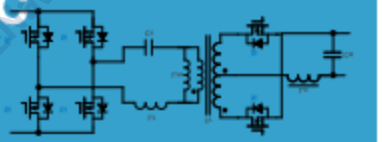
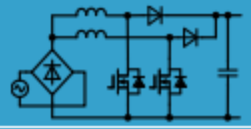
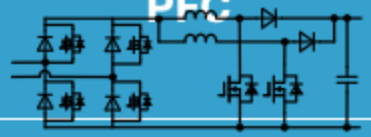
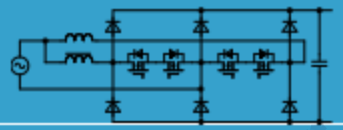
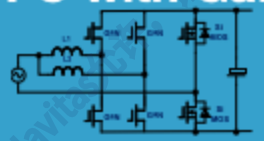
PFC 方案 \ LLC 方案	<150kHz Si based LLC 	<150kHz GaN based LLC 	300kHz GaN based LLC 	300kHz Si based LLC 
Bridge Boost PFC 	• 效率 98.2%*97.6%=95.8% • 效率不满足	• 效率 98.2%*97.7%=95.9% • 效率不满足	效率 98.2%*97.4%=95.6% • 效率不满足	效率 98.2%*97%=95.2% • 效率不满足
Active Bridge Boost PFC 	• 效率 98.6%*97.6%=96.2% • 占用空间大，成本高	• 效率 98.6%*97.7%=96.3% • 占用空间大，成本高	• 效率 98.6%*97.4%=96.0% • 占用空间大，成本高	效率98.6%*97%=95.6% • 占用空间大，成本高
Bridgeless H-PFC 	• 效率 98.4%*97.6%=96.0% • MOS数量多，成本高 • 驱动复杂	• 效率 98.4%*97.7%=96.1% • MOS数量多，成本高 • 驱动复杂	• 效率 98.4%*97.4%=95.8% • MOS数量多，成本高 • 驱动复杂	效率98.4%*97%=95.4% • MOS数量多，成本高 • 驱动复杂
Bridgeless Totem PFC with GaN 	• 效率 98.8%*97.6%=96.4% • 管子数量少，成本合理	• 效率 98.8%*97.7%=96.5% • 效率裕量高，钛金Plus	• 效率 98.8%*97.4%=96.2% • 管子数量少，成本合理 • 空间小，成本低	效率98.8%*97%=95.8% • 效率不满足

➢ 基于GaN的无桥图腾柱PFC是实现3200W高功率密度的同时，保持钛金效率的优选方案

CRPS185 3200W钛金服务器电源技术方案讨论

Navitas

Parameter	Si(IPT60R055CFD7)	SiC(G3F45MT06L)	GaN(NV6512C)	Remark
$R_{DS(ON)}$ vs Temp (@100° C)	1.65x	**1.1x**	1.75x	Lower is better, lower conduction loss
Temp rating(T_{jmax})	150° C	**175°** C	150° C	Higher is better
Q_g	67nC	47nC	**10.5nC**	Lower is better, Lower driver loss
$Q_{co(tr)}$	987pF	158pF	**139pF**	Lower is better, Lower switching loss
Q_{rr}	1220nC	102nC	**0**	Lower is better, Lower reverse recovery loss
$V_{GS(TH)\_min}$	**3.5V**	2.1V	Integrated driver	Higher is better, Easier to drive

- SiC 更适合用于大电流，对热要求较高的场合
- GaN 更适合用于高频，效率要求更高的场合

CRPS185 3200W钛金服务器电源技术方案讨论

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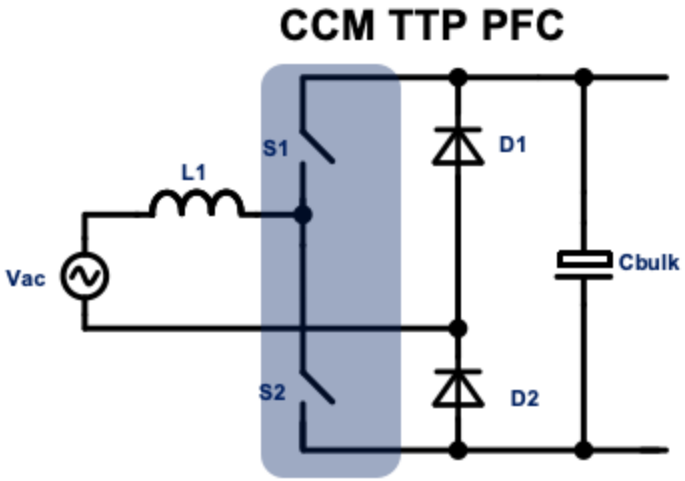
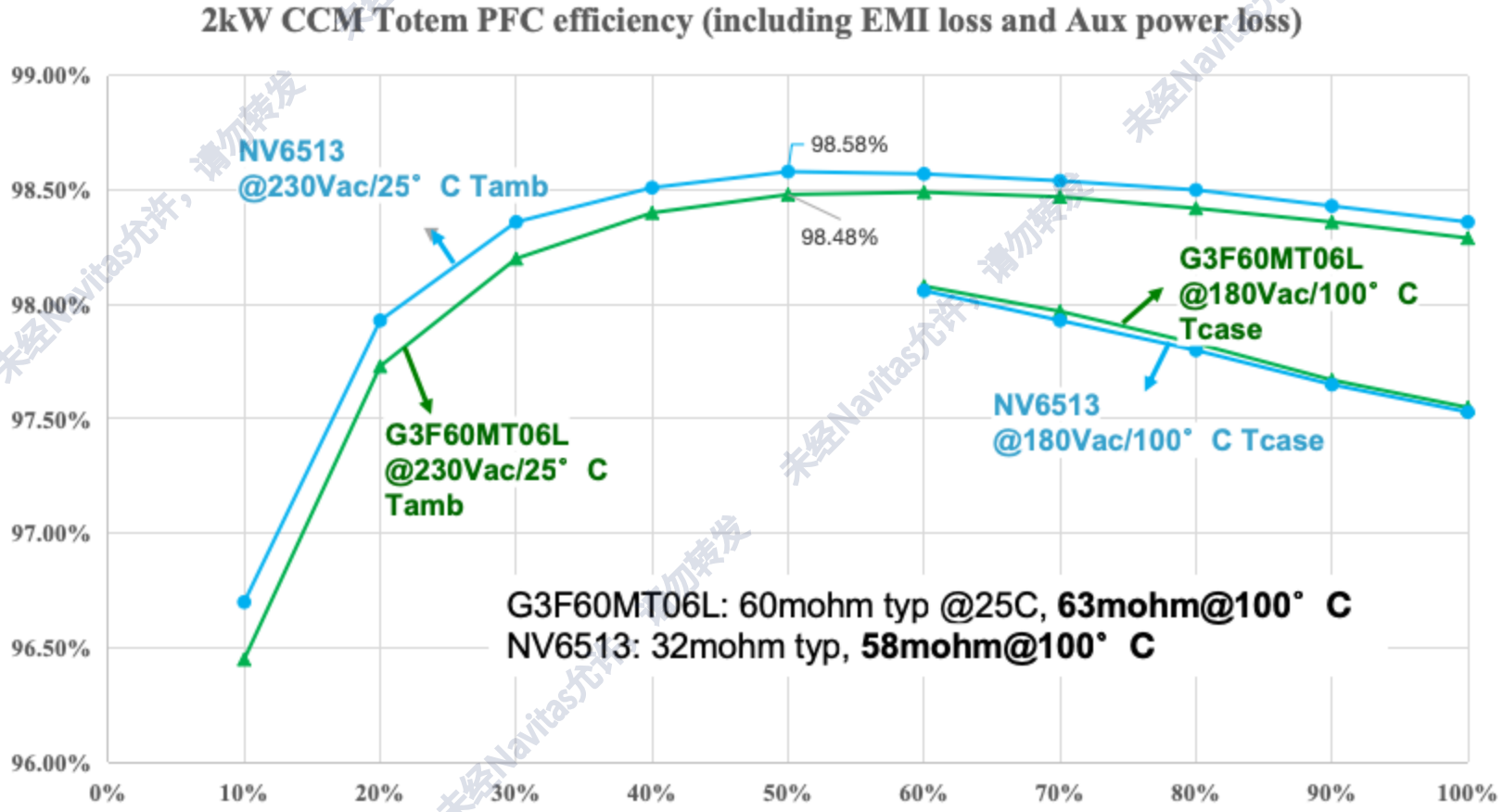


SiC (Navitas:G3F60MT06L)

- Rdson=**60mohm typ**
- Rdson @100C =**63mohm**
- Qrr =**102nC**
- Co(tr)=**158pF**
- Qg=**47nC**

GaN (Navitas:NV6513)

- Rdson=**32mohm typ**
- Rdson@100C= **58mohm**
- Qrr= **0**
- Co(tr)=**139pF**
- Qg=**10.5nC**

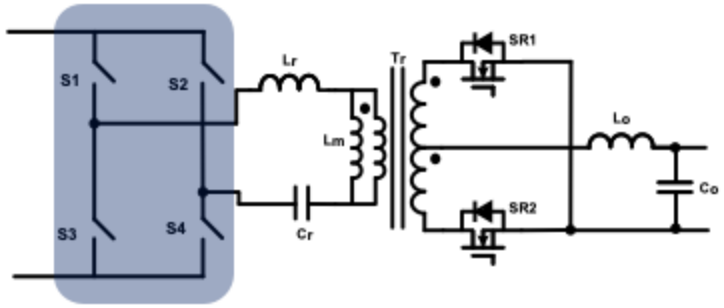


➢ 在PFC级效率上，GaN 比SiC略高一点

CRPS185 3200W钛金服务器电源技术方案讨论

Navitas

Full bridge LLC



Si (IFX:IPT60R055CFD7)

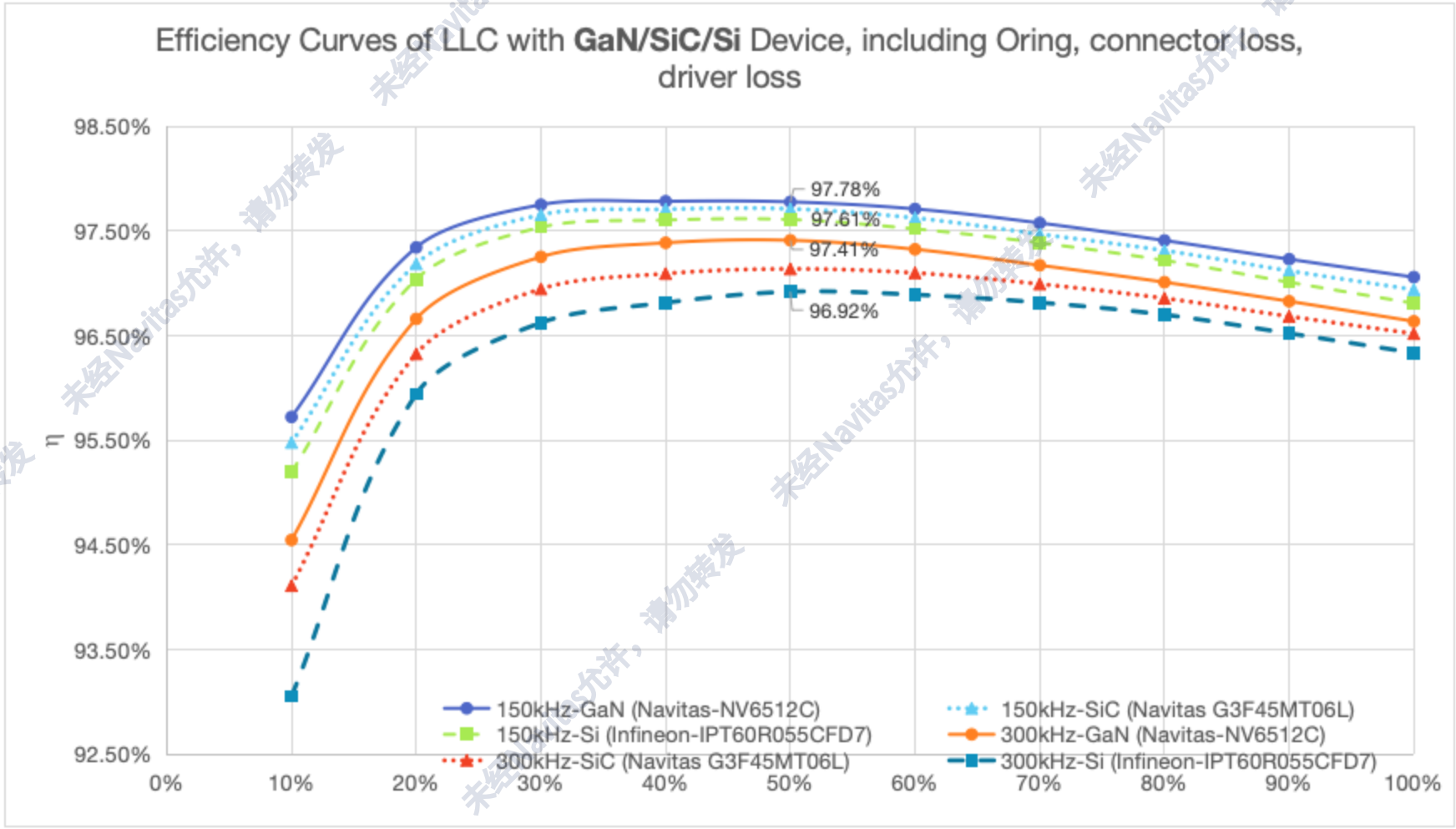
- Rdson=45mohm typ, 55mohm max
- Co(tr)=**987pF**
- Qg=**67nC**

SiC (Navitas:G3F45MT06L)

- Rdson=45mohm typ, 60mohm max
- Co(tr)=158pF
- Qg=47nC

GaN (Navitas:NV6512C)

- Rdson=45mohm typ, 55mohm max
- Co(tr)=**139pF**
- Qg=**10.5nC**



➢ When freq increased from 100kHz to 300kHz,

1) Si MOS eff will drop a lot→ Si MOS can NOT be used in high frequency application
2) GaN can keep higher eff, especially at light load→ GaN is preferred in high frequency

纳微GaNsafe™: 集成E-Mode GaN

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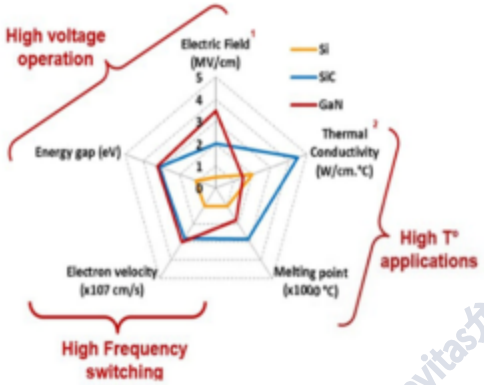
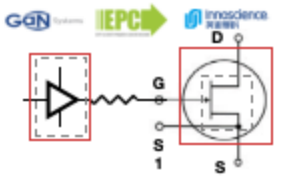
GaN Physical Performance



eMode FET *(normally off)*

- 需要特殊的6V专有控制器
- 驱动和GaN是分立的，对Layout要求比较高并且容易受干扰
- 驱动的可靠性和一致性目前还没有确认

Panasonic Infineon GaN Systems EPC Innoscience

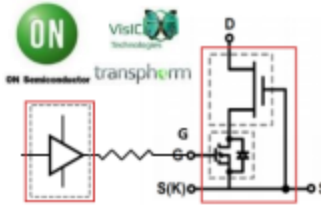


GaN Discrete

Complex gate drive

dMode FET *(normally on)*

ON Semiconductor VisIC Technologies transphorm



Extra Si FET in 'cascode' configuration

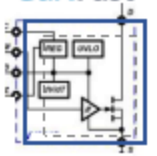
- 两颗chip（一颗Si mos，一颗GaN die）
- 没有驱动控制dv/dt
- 没有任何保护

Si Mos，易驱动

Integration

Navitas

GaNFast™



Power IC

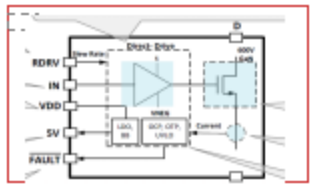
GaN Power (FET), GaN Drive, Control, Protection

120+ Patents

- 兼容所有的现有PWM控制器
- 0寄生参数消除开关尖峰噪声，保证Gate可靠性及高频下工作
- Dv/dt和EMI控制

Co-pack

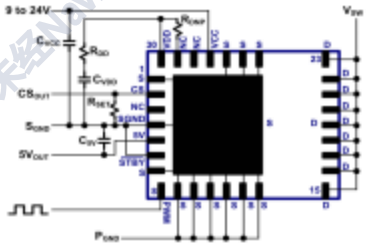
Texas Instruments



Si controller/driver + Si FET cascode + GaN dMode FET

- 驱动和GaN集成
- dv/dt和EMI控制
- OCP/OTP/UVLO

GaNFast™ with GaNSense™



- 兼容所有的现有PWM控制器
- 0寄生参数消除开关尖峰噪声，保证Gate可靠性及高频下工作
- Dv/dt和EMI控制
- OTP/OCP/UVLO保护
- 集成Rcs，减小BOM，提升效率

纳微GaNsafe™: 集成，可靠，安全

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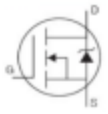
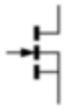
Si MOSFET
GaN



- Old, slow
- High Q_g
- High C_{OSS}
- F_{SW} < 100 kHz

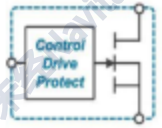
Discrete



- External gate drive
- dV/dt sensitivity
- Layout sensitivity
- ESD sensitivity
- Unknown reliability
- Unknown robustness

GaNFast™

200-300 kHz

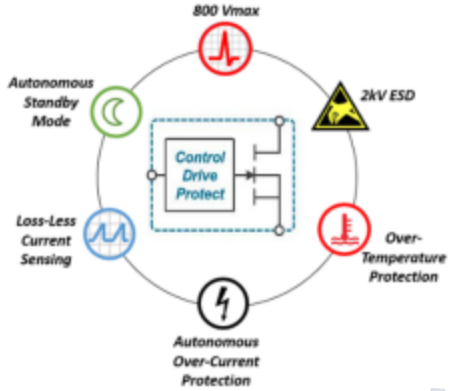


GaNFast:

- ✓ Internal Gate
- ✓ Integrated Gate Drive
- ✓ dV/dt Immunity
- ✓ Layout Insensitive
- ✓ 2 kV ESD rating
- ✓ Proven Reliability
- ✓ Proven Robustness

GaNSense™

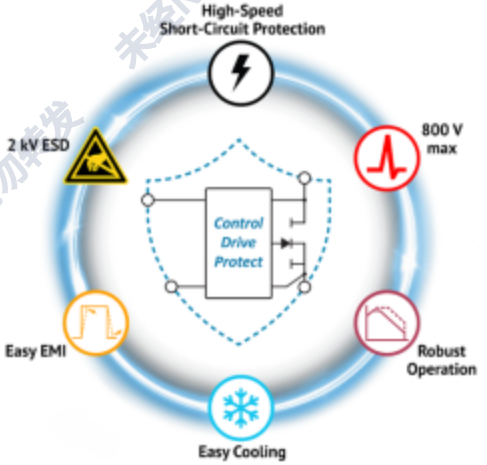
500 kHz



GaNFast plus:

- ✓ Autonomous Standby
- ✓ Autonomous Protection
- ✓ Loss-less Current Sensing
- ✓ High Precision
- ✓ High Efficiency

GaNSafe™



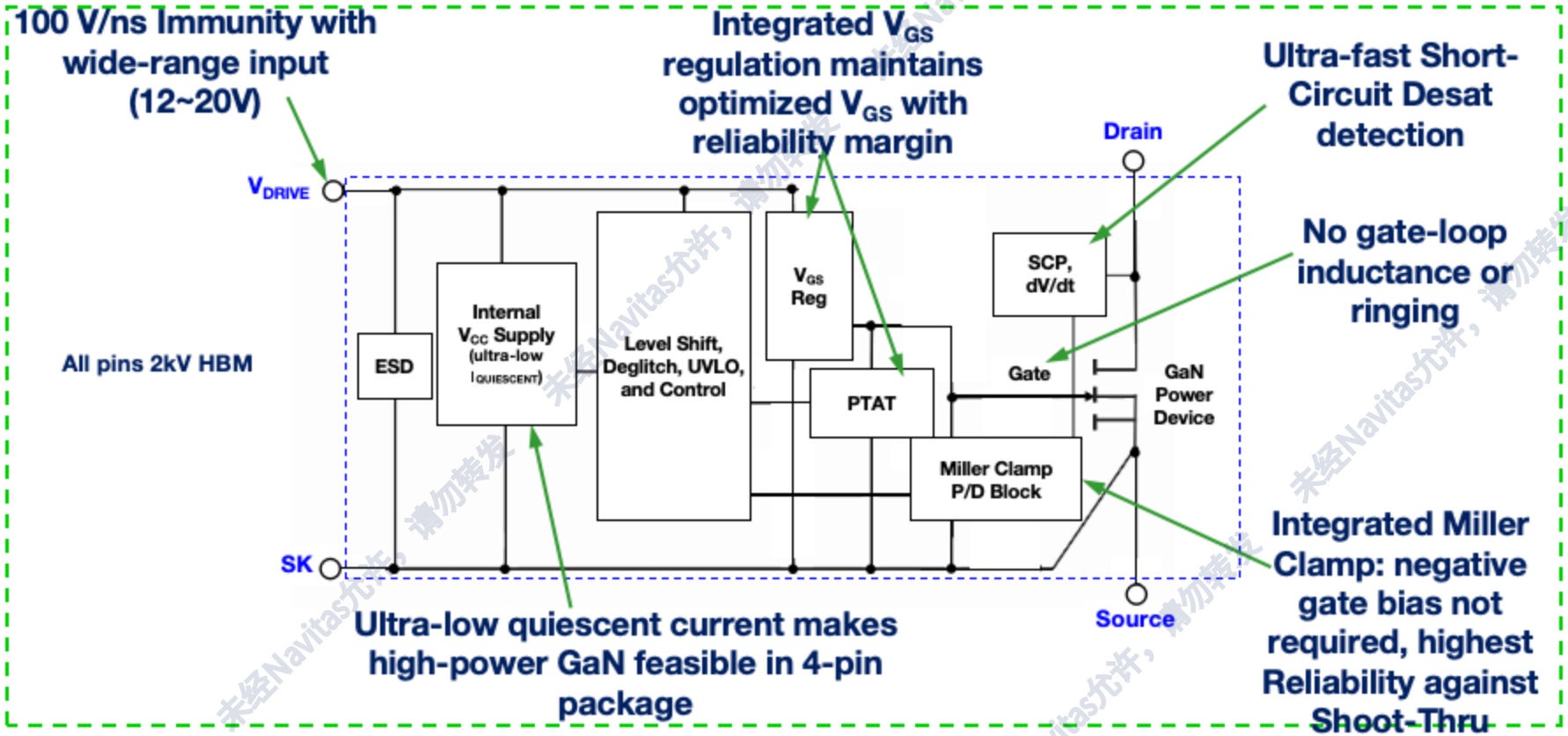
GaNSense plus:

- ✓ Desat detect Short Circuit Protection with ultra-fast 300ns latency
- ✓ Robust, thermally enhanced packaging: ultra-low $R_{\theta\_JUNC-AMB}$ and BLTC Reliability
- ✓ 4th Gen integrated GaN gate drive with positive TempCo V_{GS} regulation
- ✓ Integrated Miller Clamp (no negative gate bias, higher 3rd quadrant efficiency)

Navitas

Proved GaN Reliability in high volume segments, accelerated GaN adoption, ramped to #1 GaN Supplier

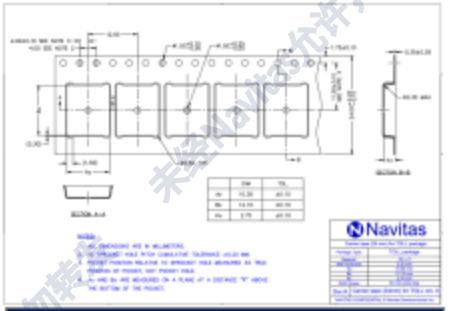
纳微GaNsafe™: 4-pins 下实现高可靠大功率集成GaN



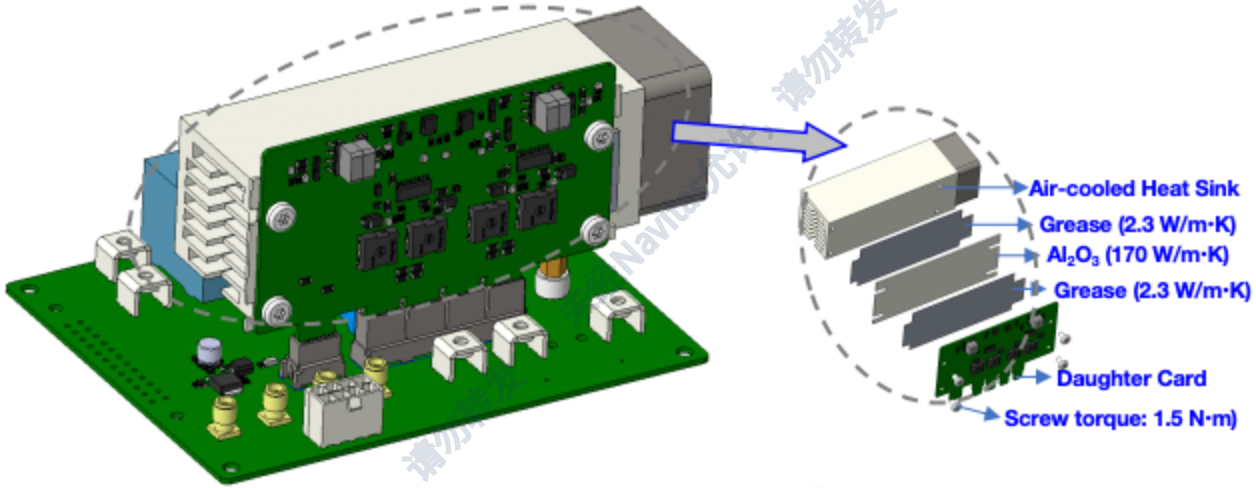
- 集成驱动，无需负压关断，外部驱动电路与Si 兼容
- 内部驱动电压Vgs随温度变化可补偿，保证Vgs工作在最优区间
- 开通关断 dv/dt可调，易于EMI调试
- SCP短路电流保护(300ns以内延时)，CBC方式

纳微GaNsafe™: 产品列表 & EVB

Part#	V_{DS} (Cont, Max) (V)	V_{DS} (Dyn, Max) (V)	$R_{DS(ON)}$ (Max 25°C) (mΩ)	I_D (Max) (A)	Package	Evaluation Kit
NV6515	650	800	35	57	TOLL 10x10 Bottom-cool 	Power Board, Full Bridge Daughter Card, and FanSink/TIM ~ configurable for DPT or Half-Bridge testing
NV6513			45	48		
NV6512			55	34		
NV6511			98	22		



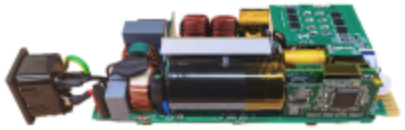
TnR Ordering	
Mini-Reel (7" dia)	Qty500 Pcs "-MR" suffix
Standard (13" dia)	Qty2,000 Pcs



1. Samples and collateral available immediately to qualified customers

纳微加速GaN TTM: 特有的系统设计中心

Navitas

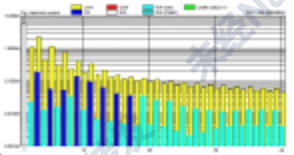


Power System *Platform* Design

High Frequency, High Efficiency, High Density, High Integration

System design evaluation & feedback

Electrical, thermal, mechanical, EMI, BOM cost, manufacturing and yields

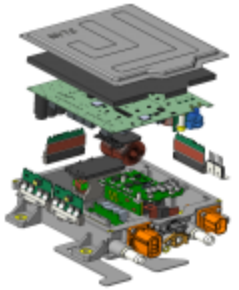


Semiconductor Design

Application-specific GaN / SiC

Customer Co-Development

Joint Labs / Joint Development

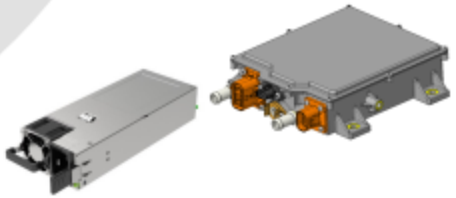


System know-how drives innovation

Close customer co-op for qualification, certifications, production readiness

Mass Production

Fast time to market

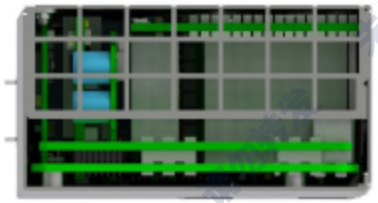


纳微CRPS185 3200W 钛金Plus服务器电源方案

Navitas

纳微 CRPS185 3200W

前视图



后视图

BRIEF SPECIFICATION

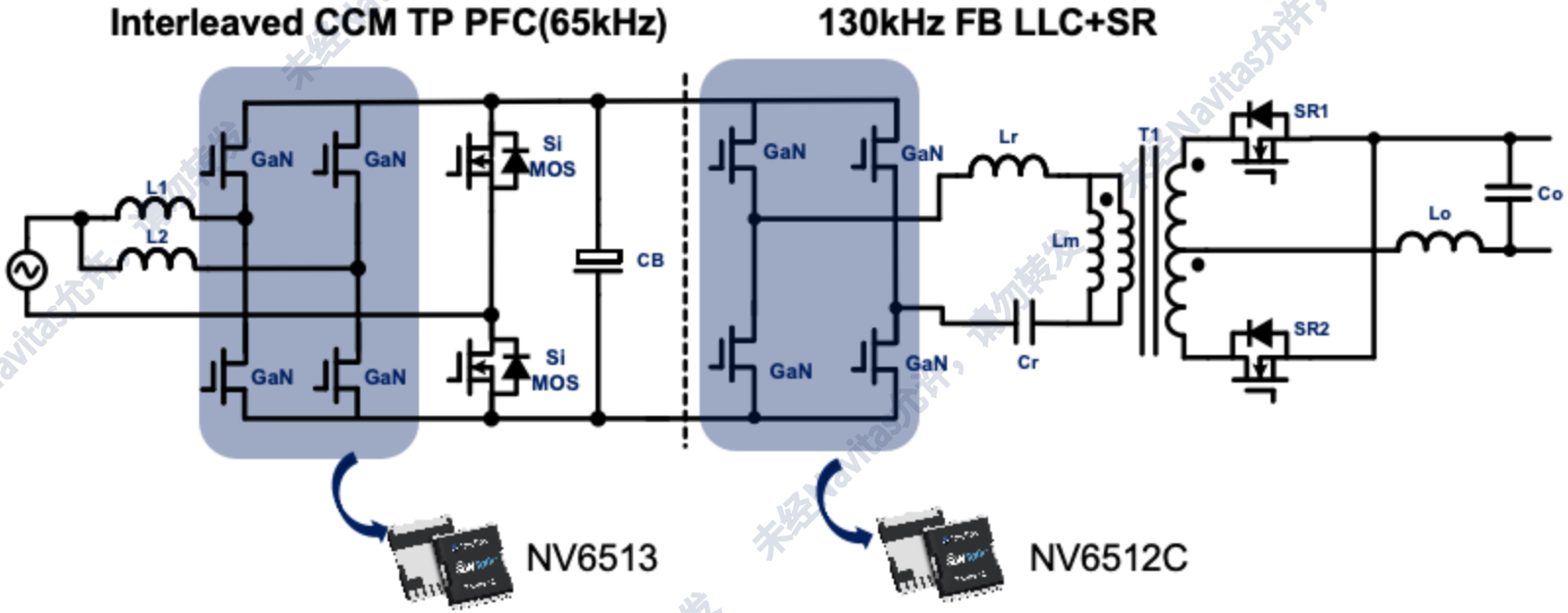
Input voltage range	HL:220 ~ 264 Vac LL:90 ~ 140 Vac
Frequency	47~63Hz
Output power(Consider C20 safety)	**3200W**@220Vac~240Vac, **3000W**@200Vac~219Vac
Output voltage & current	12.2V/262A
Standby output voltage & current	12V/2.5A
Efficiency	Titanium(>96%@50% load)
Operating temperature range	-5C~+55C
Hold up time	**14ms**@2400W, **12ms**@2700W, **10ms**@3200W
Power Density	98W/inch³
Oring	Yes
Special features	Active current sharing OC/OV/UV/OT I²C

MECHANICAL SPECIFICATION

Size L x W x H mm	185 (L)*73.5 (W)*39 (H)
Cooling	Internal fan

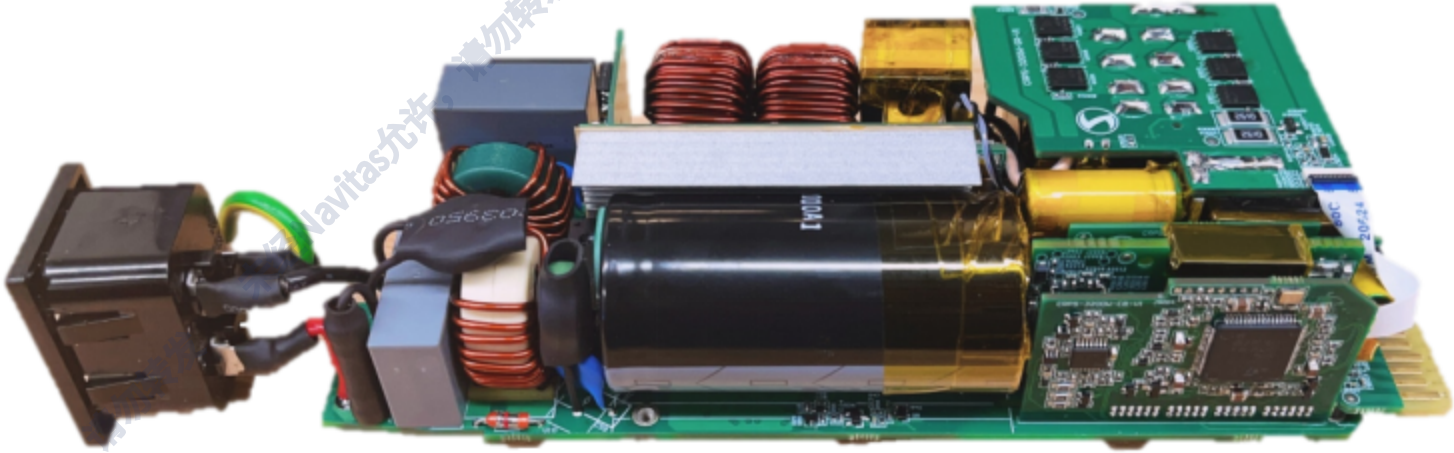
纳微CRPS185 3200W 钛金Plus服务器电源方案

Navitas



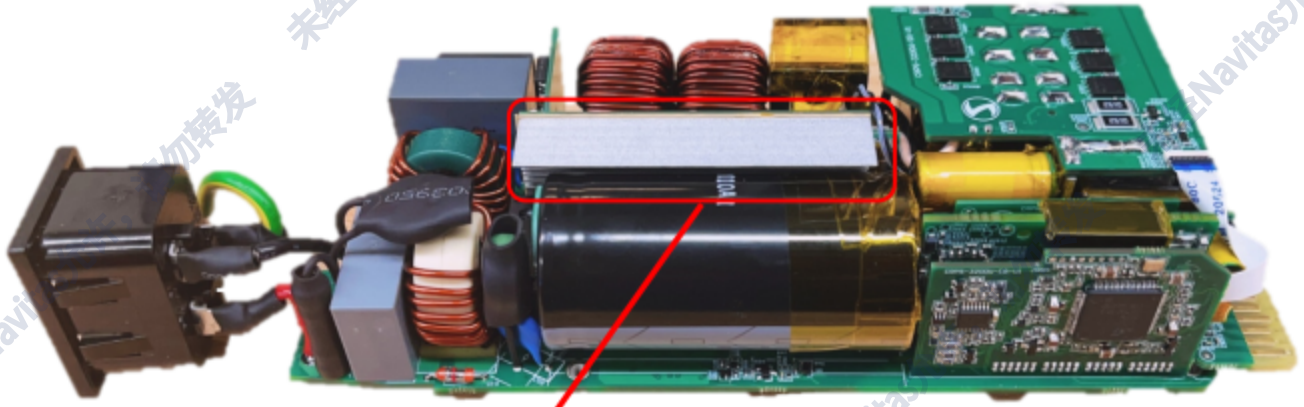
纳微 CRPS185 3200W 平台

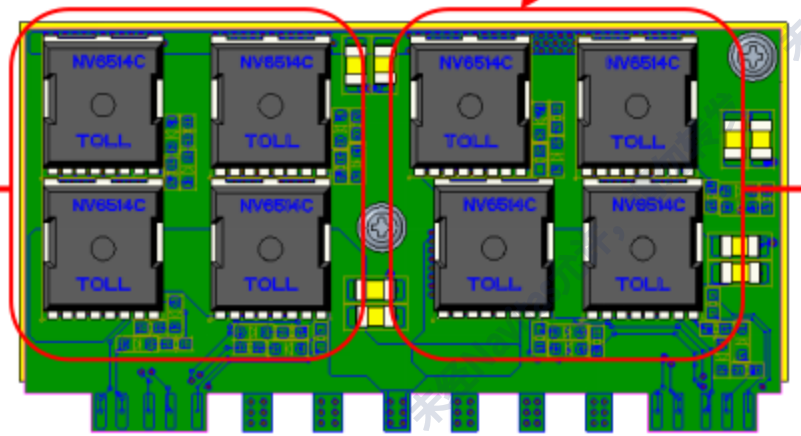
- 兼容 2.7kW, 3kW, 3.2kW
- 功率密度高达98W/inch^3
- Titanium+ Efficiency: 96.3%@50% load, >96% @20%~60% load
- Hold up time: 12ms@2700W, 10ms@3200W



纳微CRPS185 3200W 钛金Plus服务器电源方案

Navitas



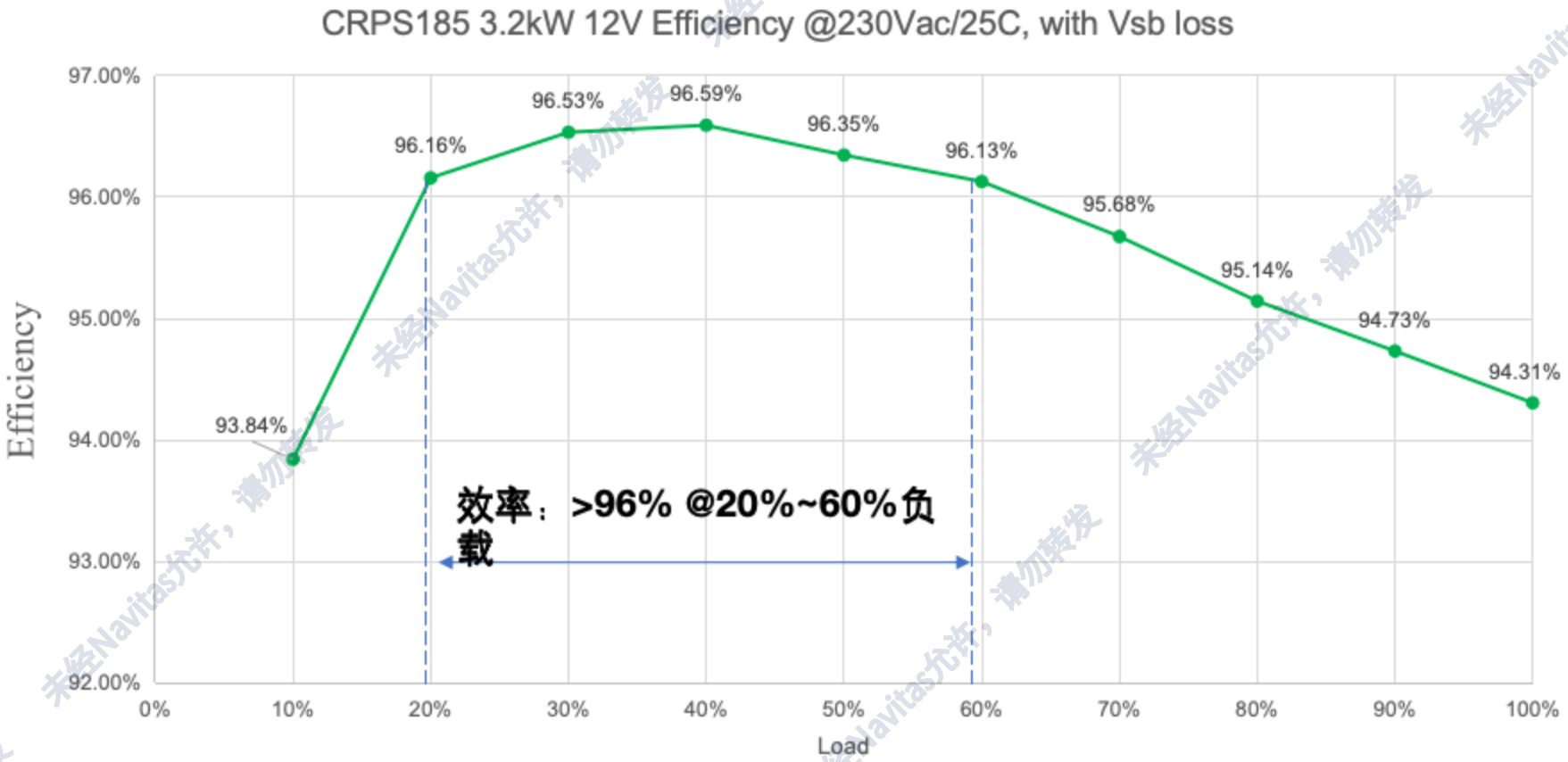


4pcs *NV6513(45mohm)
in Interleaved TPPFC

4pcs *NV6513 in FB LLC

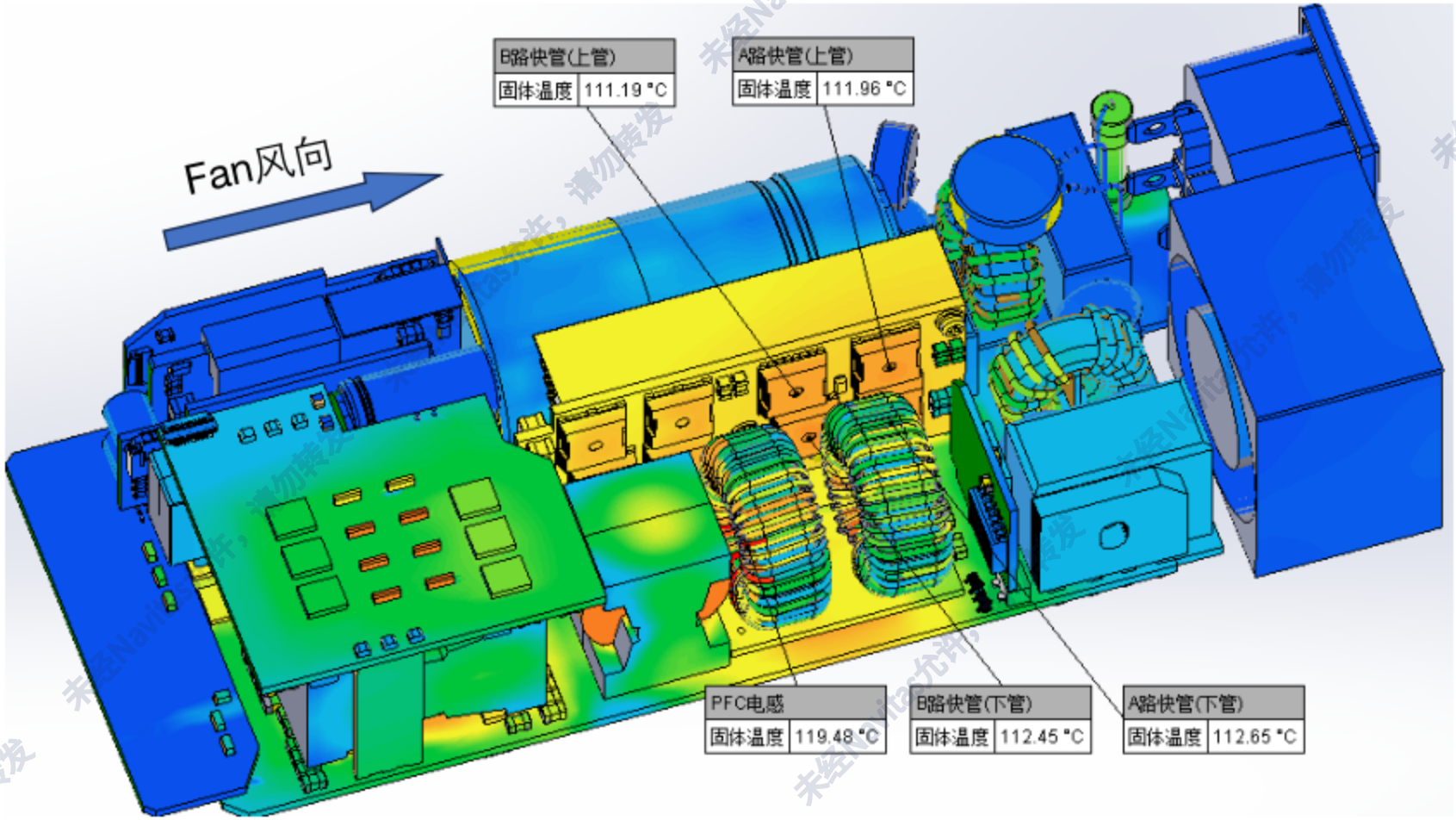
- GaN 小卡上，无任何驱动IC，极大增加了GaN layout空间散热能力

纳微CRPS185 3200W 钛金Plus服务器电源方案



- 纳微CRPS 3200W 服务器电源方案效率可以很好满足80 Plus 钛金效率要求. 其中峰值效率为 96.6%@ 40% 负载, 半载下效率为96.35%, 同时在**@ 20%~60%**负载范围内效率都 **大于96%** ， **超钛金效率（Titanium Plus）**

纳微CRPS185 3200W 钛金Plus服务器电源方案



- Thermal仿真结果显示，纳微CRPS185 3200W 电源方案可很好满足热要求(GaN器件仿真温度低于113°C)

纳微CRPS185 3200W 钛金Plus服务器电源方案

Navitas

Key Component	Test point	1. 30C 2. 180Vac 2700W 3. Fan: PFB0412EN	1. 30C 2. 200Vac 3000W 3. Fan: PFB0412EN	1. 30C 2. 220Vac 3200W 3. Fan: PFB0412EN	1. 55C 2. 200Vac 3000W 3. Fan: PFB0412EN	1. 55C 2. 220Vac 3200W 3. Fan: PFB0412EN	IPC9592B-dreating	Result
Name	Test point	Temp/℃	Temp/℃	Temp/℃	Temp/℃	Temp/℃	Temp/℃	
Ambient		30.64	30.38	31.6	55.05	53.04	-	
PFC choke	1	67.01	72.53	74.07	115.89	114.77	130	PASS
Polarity MOS	2	65.77	71.3	72.72	105.74	106.22	125	PASS
PFC GaN（high side）	3	76.05	81.52	83.07	111.92	111.29	120	PASS
PFC GaN（low side）	4	75.63	81.56	83.36	114.14	113.33	120	PASS
LLC Primary GaN	5	63.33	69.8	73.86	106.61	109.19	120	PASS
LLC resonant choke	6	68.5	77.79	81.53	112.05	116.45	130	PASS
LLC SR MOS	8	72.11	82.43	88.73	110.95	115	125	PASS
ORING MOS	9	61.47	70.8	75.22	112.26	117.13	125	PASS

- PSU在环温55℃下，在最低输入电压180Vac下，内部GaN器件最高温度低于114.14℃，可以很好满足IPC9592B 的降额要求

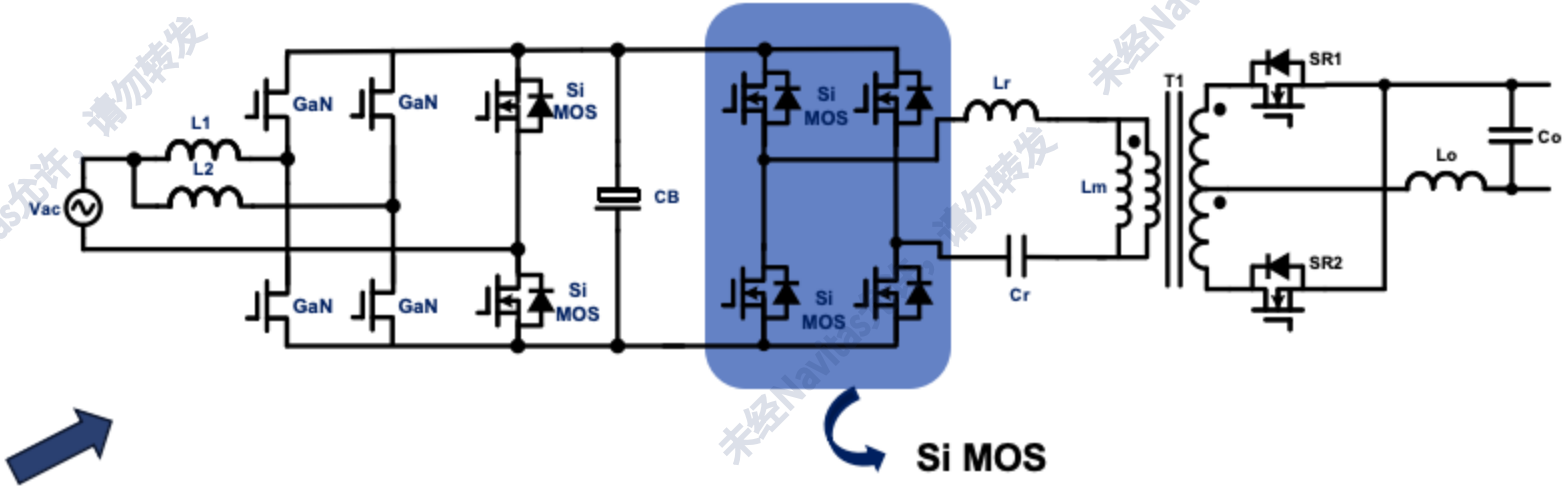
纳微CRPS185 3200W 钛金服务器电源高频化方案

Navitas

CRPS185 3200W Titanium PSU

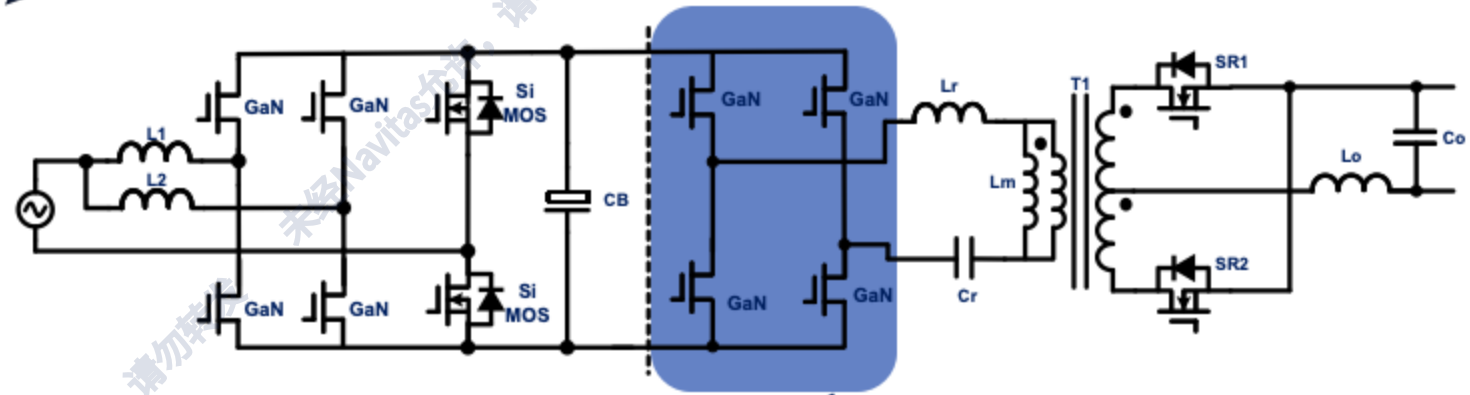
Interleaved CCM TP PFC

<150kHz Si based FB LLC



Si MOS

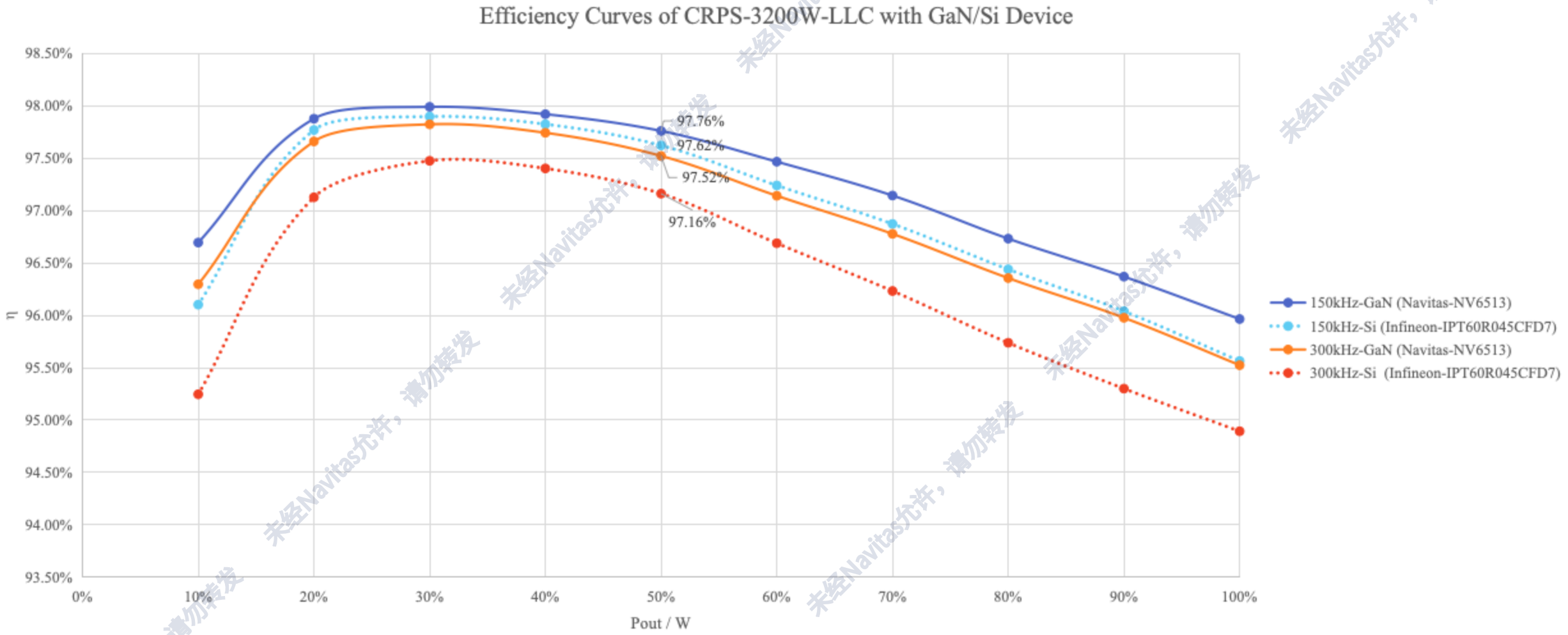
>300kHz GaN based FB LLC



GaN

纳微CRPS185 3200W 钛金服务器电源高频化方案

Navitas

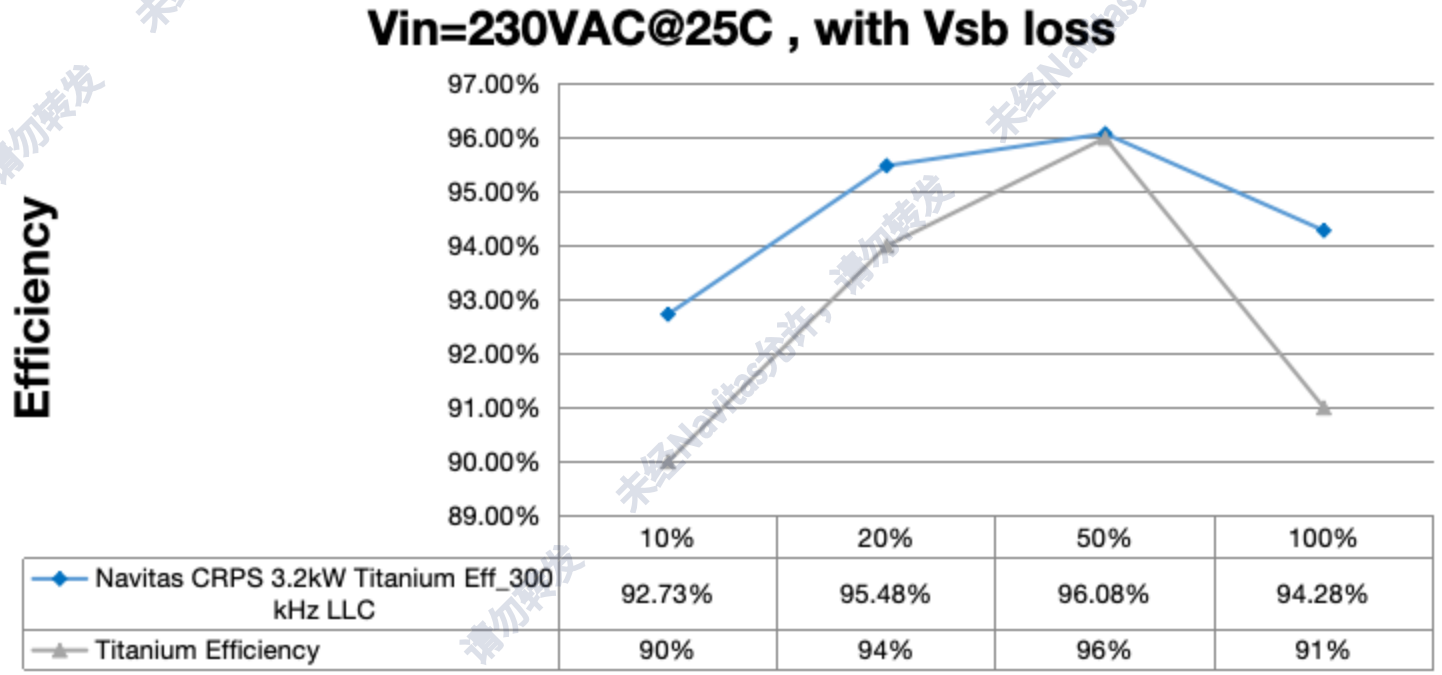


- LLC 效率：150kHz GaN LLC > 150kHz Si ≈ 300kHz GaN >>300kHz Si
- 300kHz GaN LLC 的效率略低于150kHz Si LLC的效率(0.1%左右), 依然可以实现整机的钛金效率要求

纳微CRPS185 3200W 钛金服务器电源高频化方案

Navitas

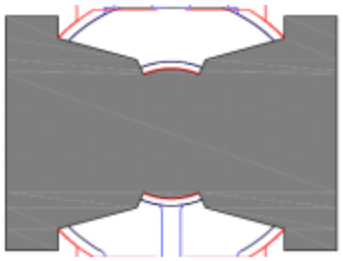
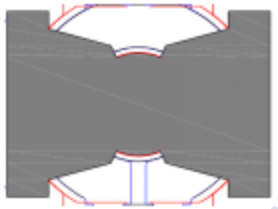
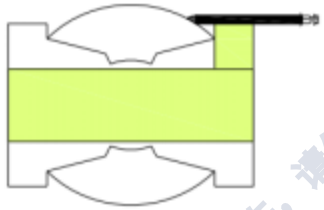
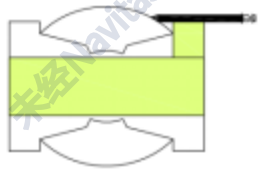
300kHz GaN based LLC CRPS185 3.2kW 12V Eff@230Vac, with Vsb loss						
Vin	Pin/W	Vout/V	Io/A	Pout/W	Eff	Load
230Vac	343.89	12.2651	26	318.8926	92.73%	10%
230Vac	667.1	12.2496	52	636.9792	95.48%	20%
230Vac	993.6	12.2374	78	954.5172	96.07%	30%
230Vac	1322.1	12.2288	104	1271.795	96.20%	40%
230Vac	1654	12.2241	130	1589.133	96.08%	50%
230Vac	1993.8	12.2389	156	1909.268	95.76%	60%
230Vac	2344.2	12.2831	182	2235.524	95.36%	70%
230Vac	2705.1	12.3367	208	2566.034	94.86%	80%
230Vac	3056.5	12.3506	234	2890.04	94.55%	90%
230Vac	3356.5	12.3619	256	3164.646	94.28%	100%



- 基于300kHz GaN LLC 的CRPS185 3200W PSU依然可以实现整机钛金效率的要求
- 副边SR依然是Si MOS, 可通过进一步降低驱动损耗或改用GaN提高效率

纳微CRPS185 3200W 钛金服务器电源高频化方案

Navitas

	Si基150kHz 3200W LLC		GaN 基300kHz 3200W LLC
Main Transformer	 PQ3628 Size: 36mm*28mm*24mm	→	 PQ3033 Size: 30mm*33mm*21mm
Resonant Choke	 PQ2618: Size: 26mm*18mm*19mm	→	 PQ2018 Size: 20mm*18mm*14mm
Resonant Capacitor & Output MLCC	 630V 10nF 1206 *40pcs 16V 10uF 1206 *64pcs	→	 630V 10nF 1206 *12pcs 16V 10uF 1206 *50pcs
Primary Switch	 IPT60R055CFD7 *4pcs	→	 NV6512C *4pcs

➢ LLC频率提高至300kHz后，LLC体积有近**15%~20%** 的下降

纳微CRPS185 3200W 钛金服务器电源高频化方案

Navitas

CRPS185 3200W 12V Titanium PSU LLC 方案对比

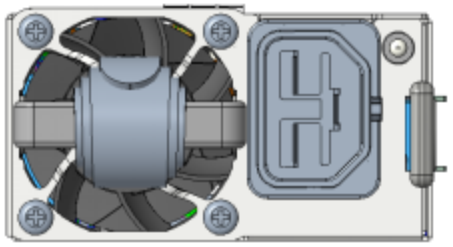
LLC方案	150kHz Full bridge LLC with Si (IPT60R055CFD7, 55mohm)	300kHz Full bridge LLC with GaN (NV6512C, 55mohm)	Remark/Cost Gap
LLC 效率	~97.6% @50% load	~97.5% @50% load	300kHz GaN LLC 依然可以实现整机钛金效率要求
LLC谐振电容	100nF, 1206 10nF *40pcs	30nF, 1206 10nF*12pcs	70% 成本降低
LLC谐振电感	PQ2718	PQ2018	15%成本降低
LLC主变压器	PQ3628	PQ3033	15%成本降低
LLC输出瓷片电容	1206 10uF*66pcs	1206 10uF*50pcs	25%成本降低
LLC总成本			>$1.7成本降低 >5%LLC系统成本降低

- 300kHz GaN基3200W LLC 效率略低于150kHz Si 基 LLC(0.1%左右), 因此300kHz GaN 基 LLC **依然能很好满足钛金效率要求**
- 采用300kHz LLC，体积将降低**15%~20%**，总成本可以降低 **$1.7 (>5% 系统成本的降低)**

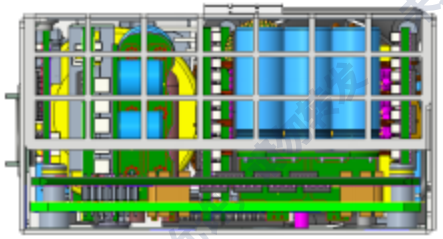
纳微CRPS185 4500W 钛金Plus服务器电源方案

Navitas

Navitas CRPS185 4500W 54V



Front Panel



Real Side

BRIEF SPECIFICATION

Input voltage range	HL:180 ~ 264 Vac LL:90 ~ 132 Vac
Frequency	47~63Hz
Output power	**4500W**@220Vac~240Vac, **4200W**@200Vac~219Vac
Output voltage & current	54V/83.3A
Standby output voltage & current	12V/2.5A
Efficiency	>**97%** peak efficiency
Operating temperature range	-5C~+55C
Hold up time	**10ms**@4200W (Bus cap: 450V/1200uF(1500uF), 30mm*70mm)
Power Density	**138W/inch³**
Oring	Yes
Special features	Active current sharing OC/OV/UV/OT I²C

MECHANICAL SPECIFICATION

Size L x W x H mm	185 (L)*73.5 (W)*39 (H)
Cooling	Internal fan

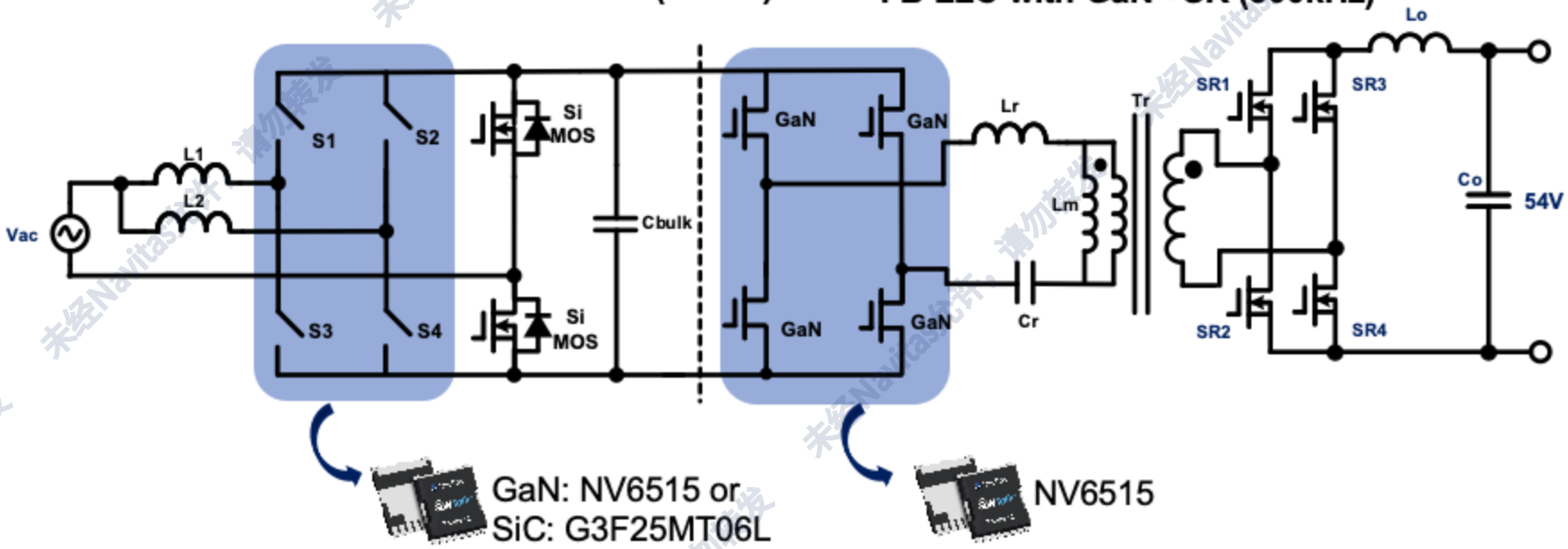
纳微CRPS185 4500W 钛金Plus服务器电源方案

Navitas

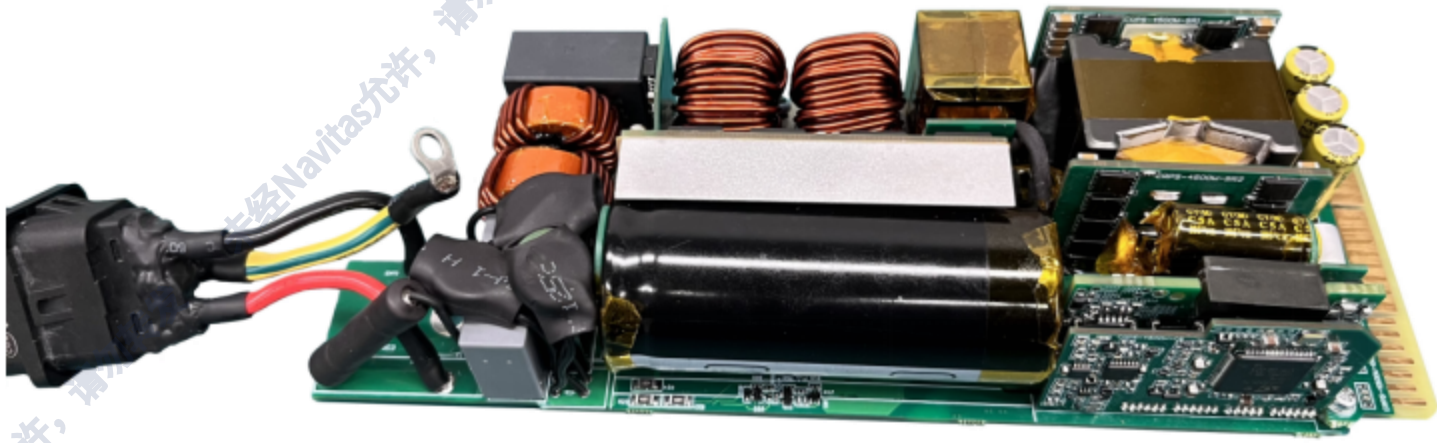
NVTS CRPS185 4500W 54V

Interleaved CCM TP PFC with SiC/GaN(80kHz)

FB LLC with GaN +SR (300kHz)

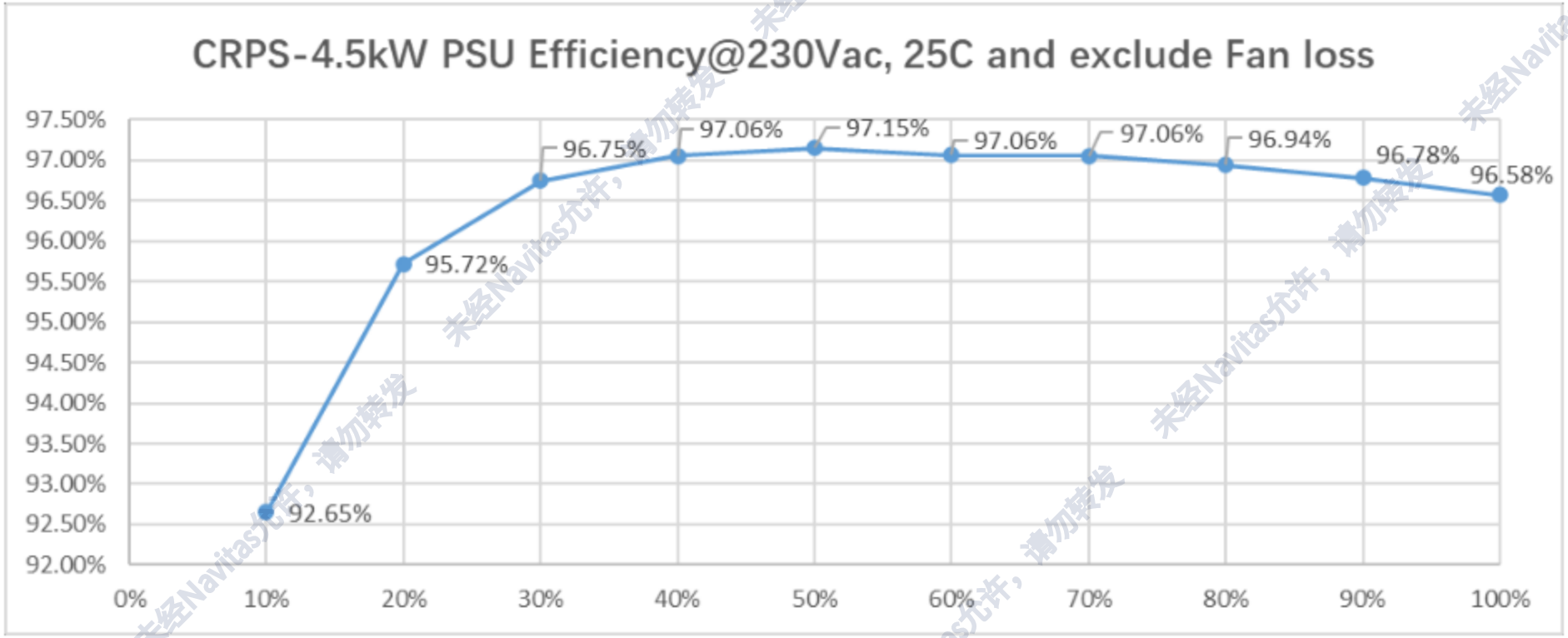


- 功率密度高达**138W/inch^3**，得益于高频LLC设计(**300kHz**谐振频率)
- 在此功率密度(开关频率)下整机效率还能 **>97%** @50% load，得益于GaN的使用
- 如果LLC SR替换为GaN，驱动损耗大幅降低，整机效率将进一步提高



纳微CRPS185 4500W 钛金Plus服务器电源方案

Navitas



- Peak efficiency: **97.15%** @50% load
- Flat efficiency curve: >96.5% @30%~100% load, >97%@40%~70% load
- Much better than Titanium Efficiency(Titanium required 96%)

纳微CRPS185 4500W 钛金Plus服务器电源方案

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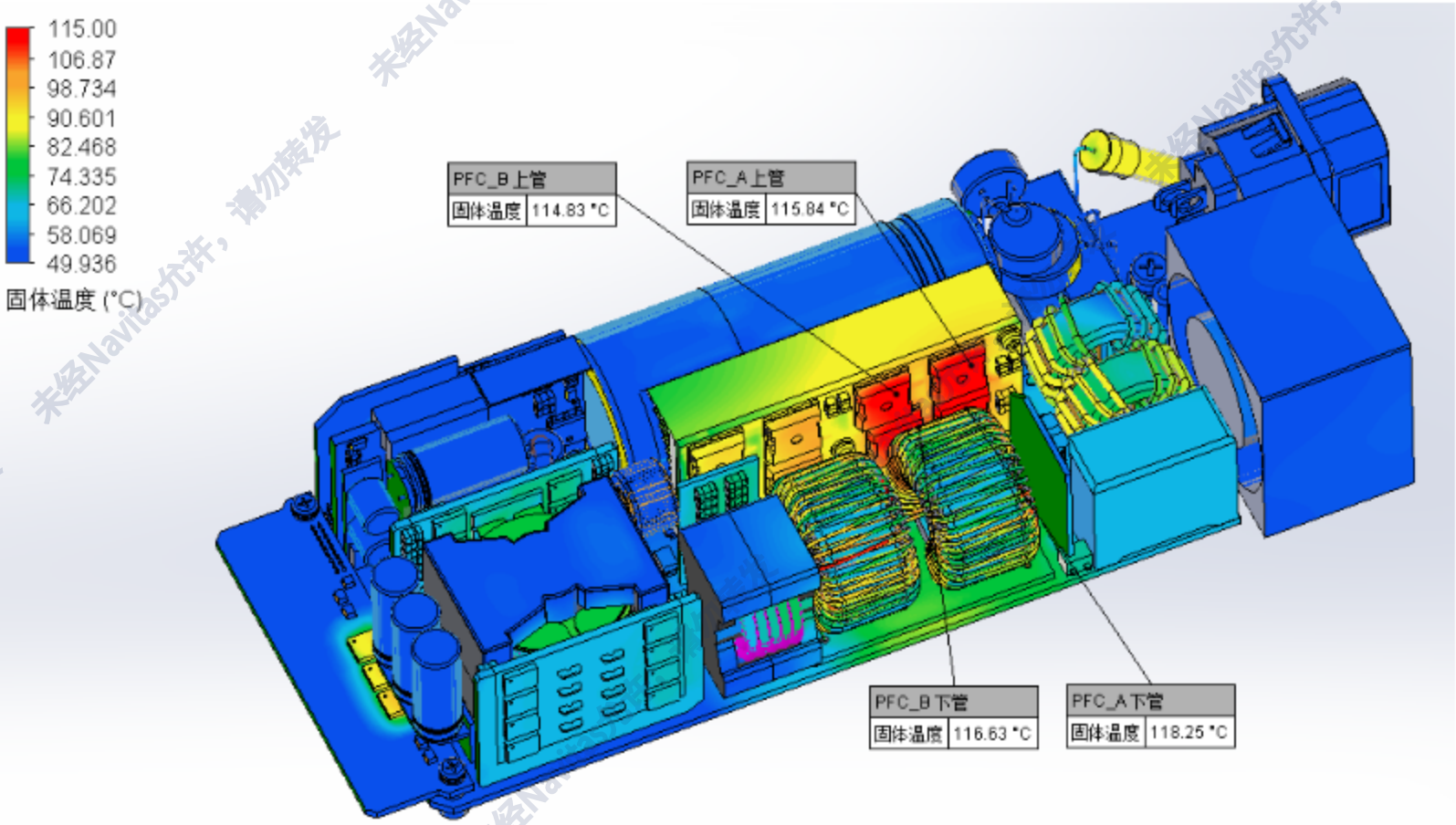
- **Thermal Simulation Condition**：
  - AVC Fan: DBPU0428B2SY016
  - Fan Speed: Full **@35000RPM**
  - Input Voltage: 220Vac
  - Output Power: 4500W
  - PSU ambient temp: **50°C**



➢ Navitas GaN based CRPS 4500W can meet 4500W@50°C，4200W@55°C, max temp is 118°C

纳微CRPS185 4500W 钛金Plus服务器电源方案

Navitas

Record Date		Project Name	Test Condition	
2023/10/20		CRPS185 4500W 54V PSU	1.220Vac/4500W 2.Fan speed is full(35000RPM) 3.12Vsb 0A	1.200Vac/4200W 2.Fan speed is full(35000RPM) 3.12Vsb 0A
Test Point	Chanel	Name	Temp/℃	Temp/℃
20	20	INLET(PSU ambient temp)	**31.82**	**32.85**
1	1	EMI Choke	49.95	47.97
3	3	PFC choke B	66.17	62.63
4	4	Polarity MOS	55.33	53.43
8	8	PFC GaN（low side）	**86.33**	**86.1**
10	10	LLC GaN（low side）	78.65	70.17
11	11	Lr	66.5	64.99
12	12	Cr	52.35	49.4
13	13	Tr	54.87	52.07
16	16	SR MOS2（SR1 board outside）	57.6	54.09
19	19	ORING MOS (BOT)	51.16	47.28

- At **33°C/ 200Vac/4200W**, the max temp is PFC lowside GaN(**86.1°C**), if inlet=55°C, then it maybe around 115°C
- At **32°C/220Vac/4500W**, the max temp is PFC lowside GaN(**86.33°C**), if inlet=50°C, then it maybe around 112°C

总结

- AI服务器迫切需要CRPS185 3200W乃至更高的4200W电源，高功率密度高效率电源是AI服务器的基础保障
- 无桥图腾柱PFC + LLC 是实现CRPS185 3200W AI服务器电源的必然选择
- SiC更适合大电流，对热要求严格的场合；GaN更适合高频，效率要求更高的场合
- 纳微GaN具有集成驱动，短路电流保护等功能，有效解决了GaN驱动敏感等问题；纳微SiC具有内阻温漂小，超强的短路电流能力等突出优势
- 基于纳微SiC/GaN的CRPS185 3200W解决方案可以实现超钛金(钛金Plus)效率
- 300kHz GaN基 3200W LLC可以在满足整机钛金效率要求前提下，大幅缩小LLC体积，同时节省LLC系统成本
- 300kHz GaN基LLC不仅可以助力实现CRPS185 4500W 高达138W/inch^3的功率密度，还可实现>97%的整机效率

“全面专注下一代功率半导体，
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