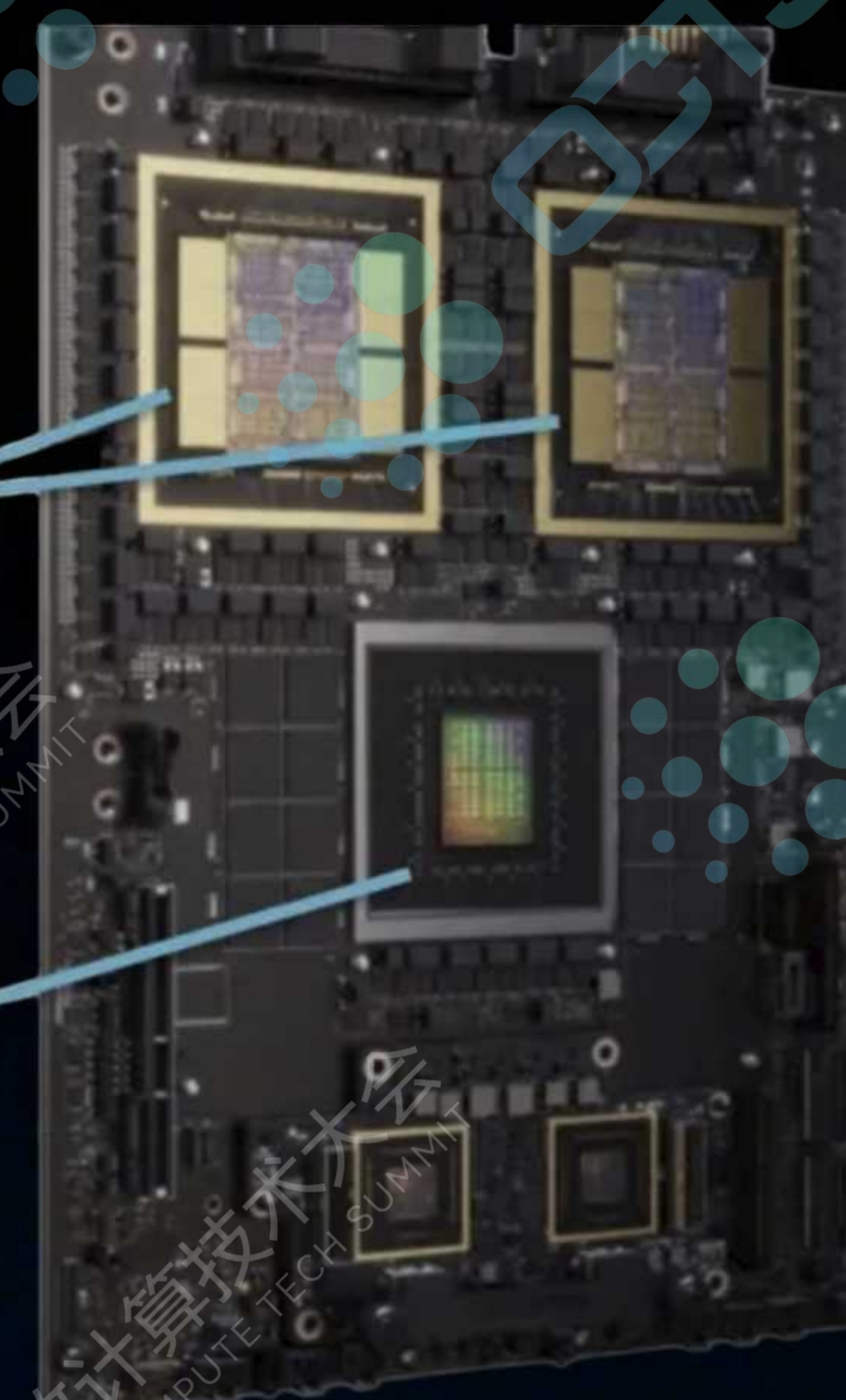
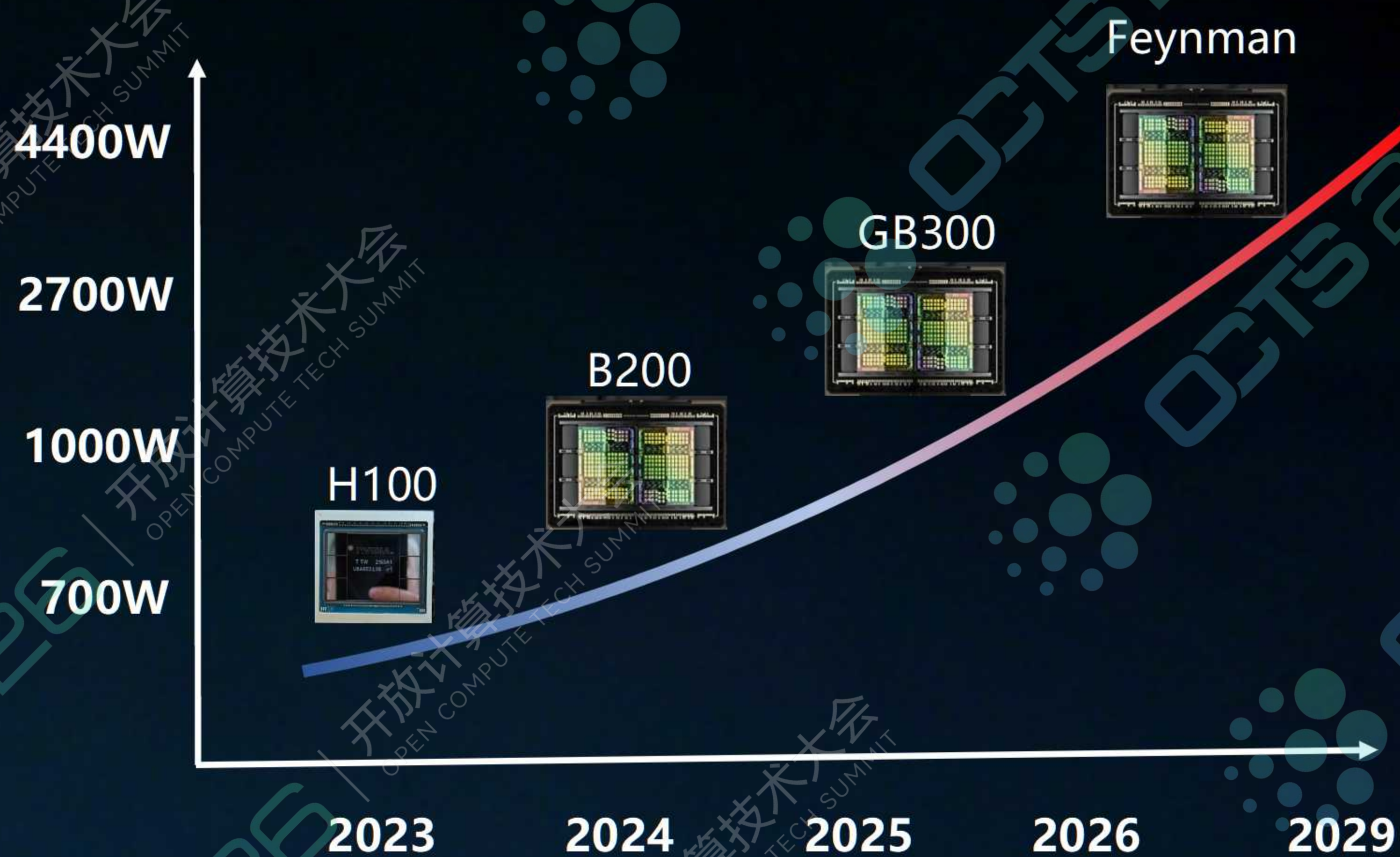


数据中心多相电源方案的发展趋势

付迎宾

XPU发展趋势

主流GPU功耗情况



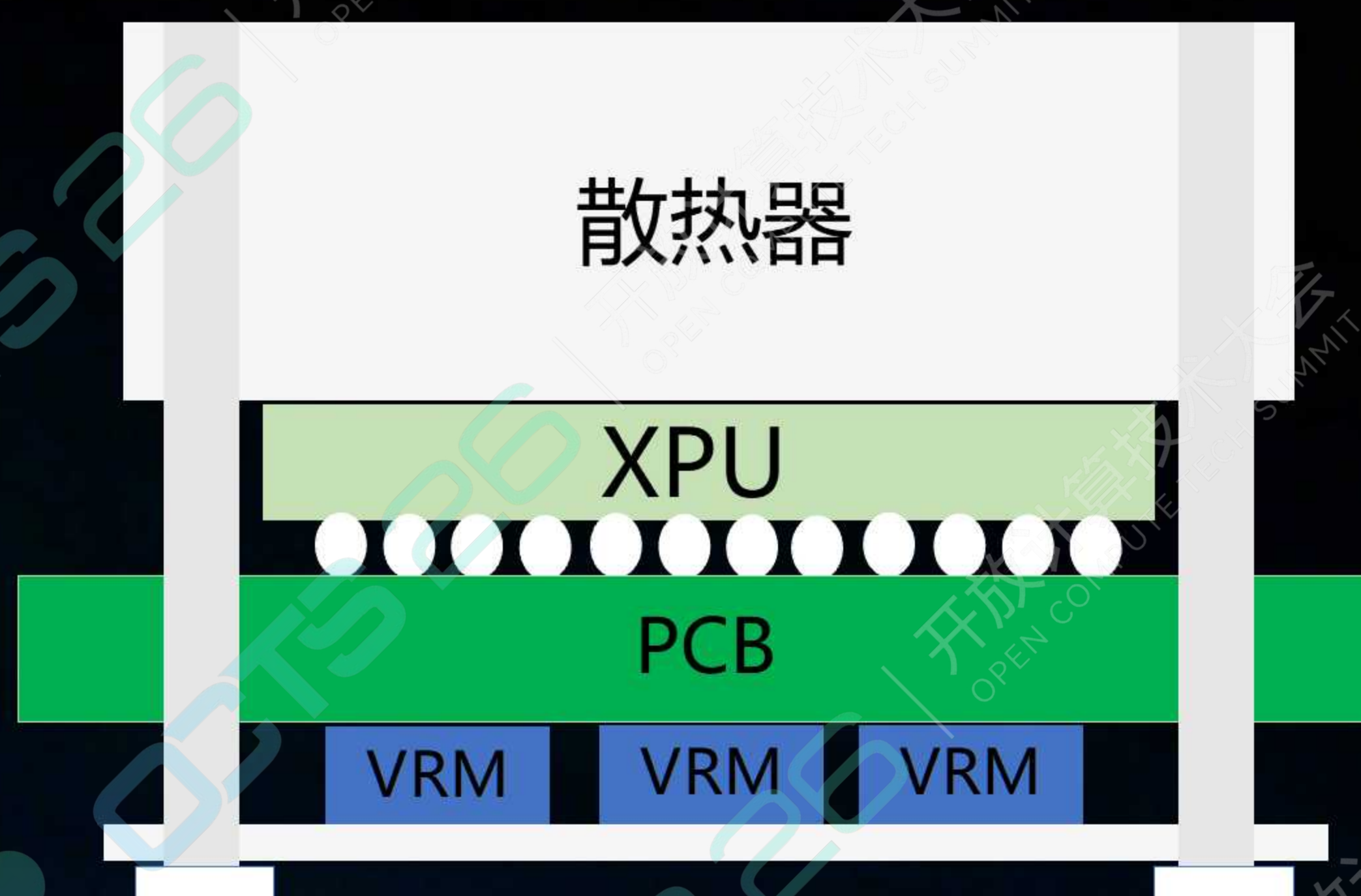
NVIDIA GB300

- B300 TDP=1200W
- Power consumption: 300W+2x1200W=2700W

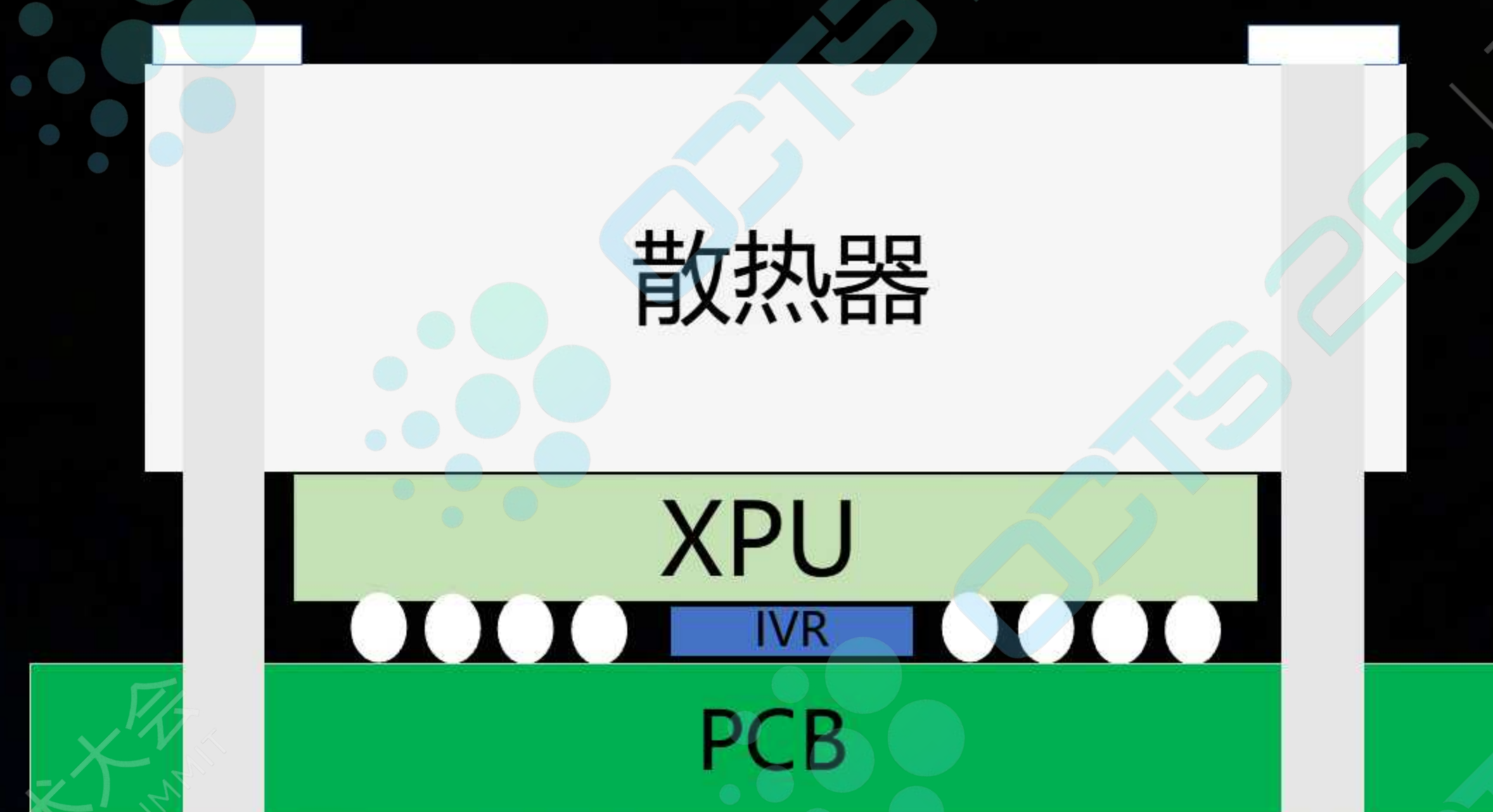
供电形态演进方向



板级 VRM：工作频率 1.0MHz
总线电压演进：48V-12V-1V



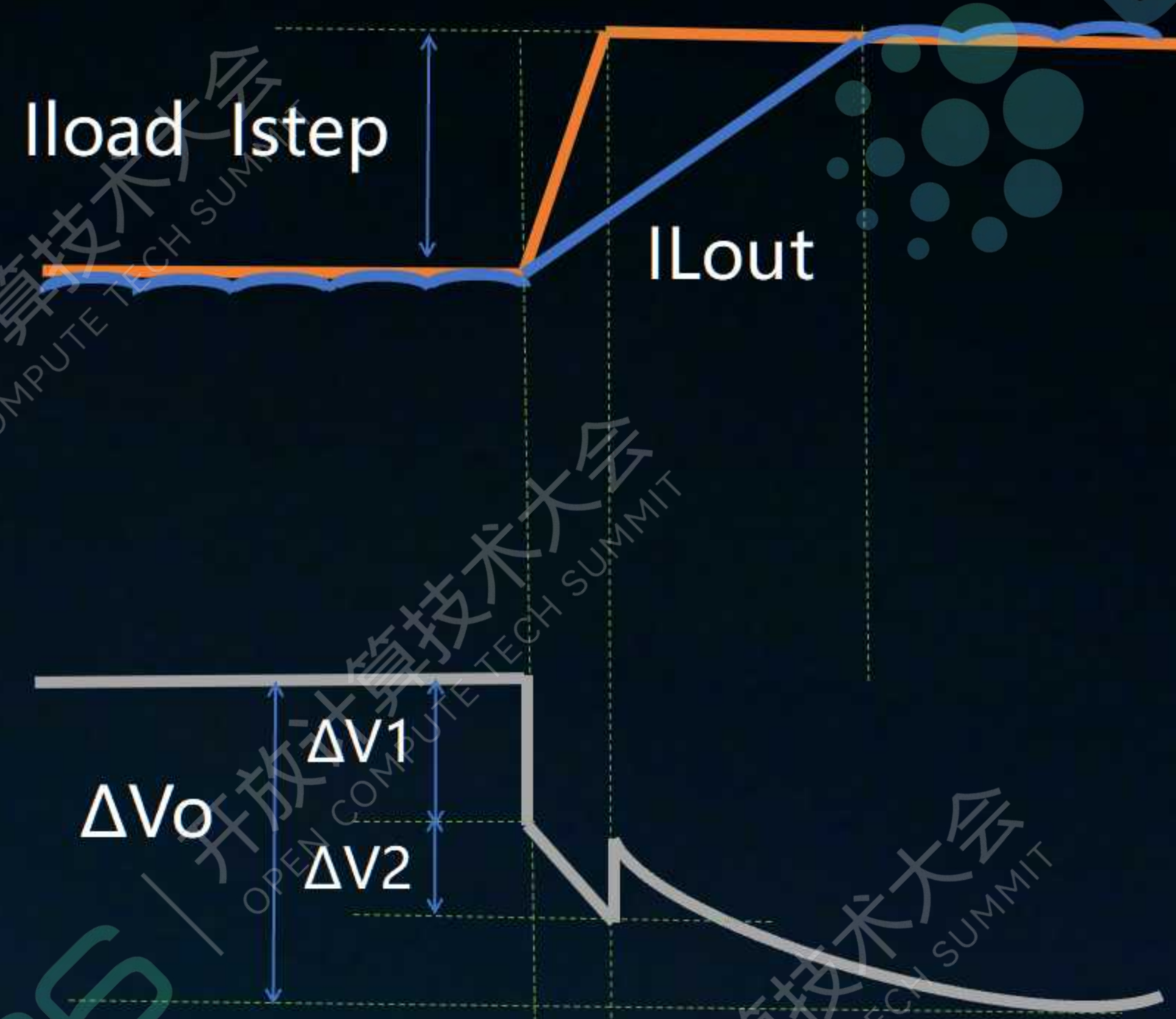
垂直VPD：工作频率 3.0MHz
总线电压演进：48V-6V/5V-1V



IVR：工作频率 >10MHz
总线电压演进：48V-3.3V-1V

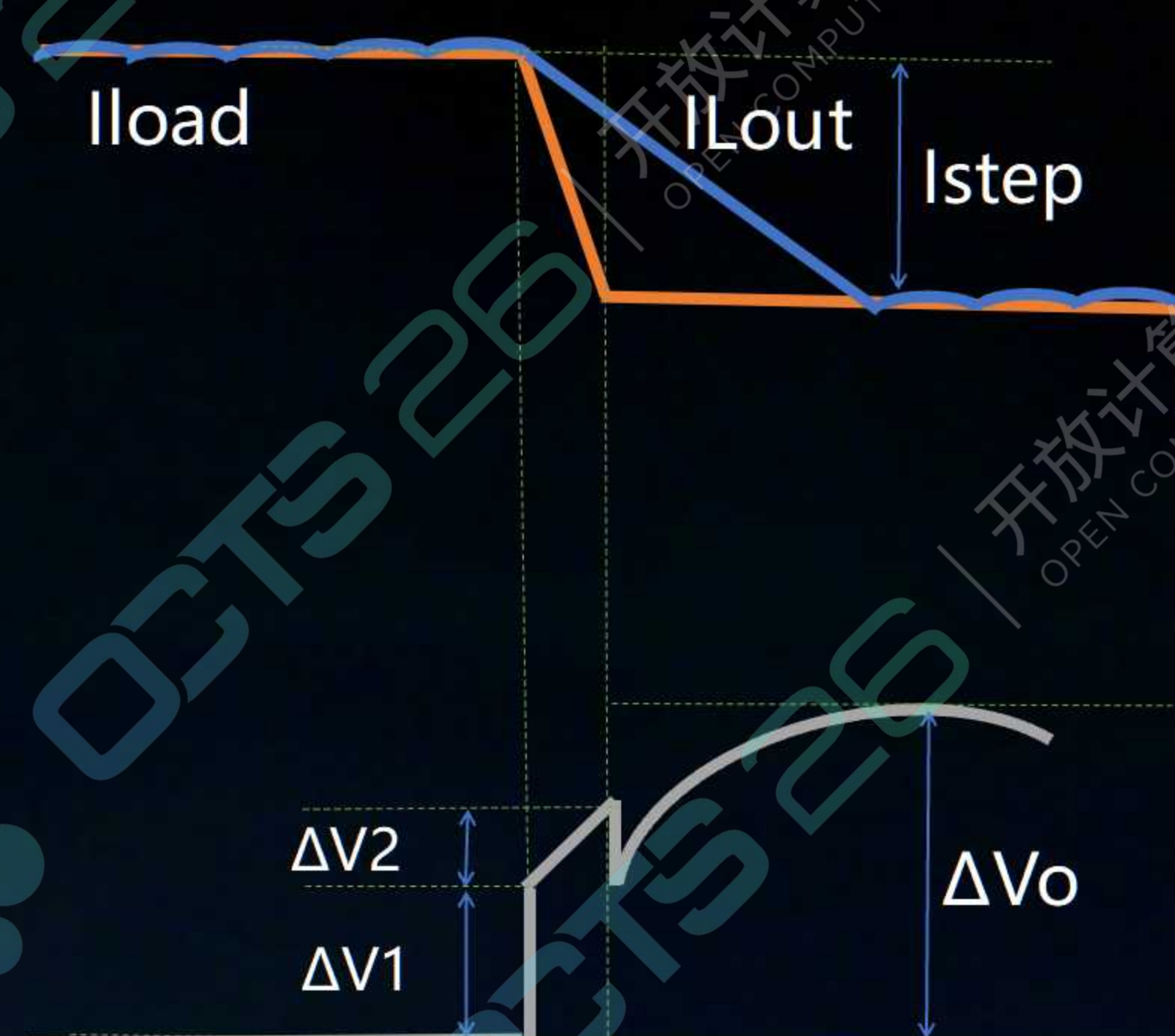
XPU对电源动态的要求

突然加载过程

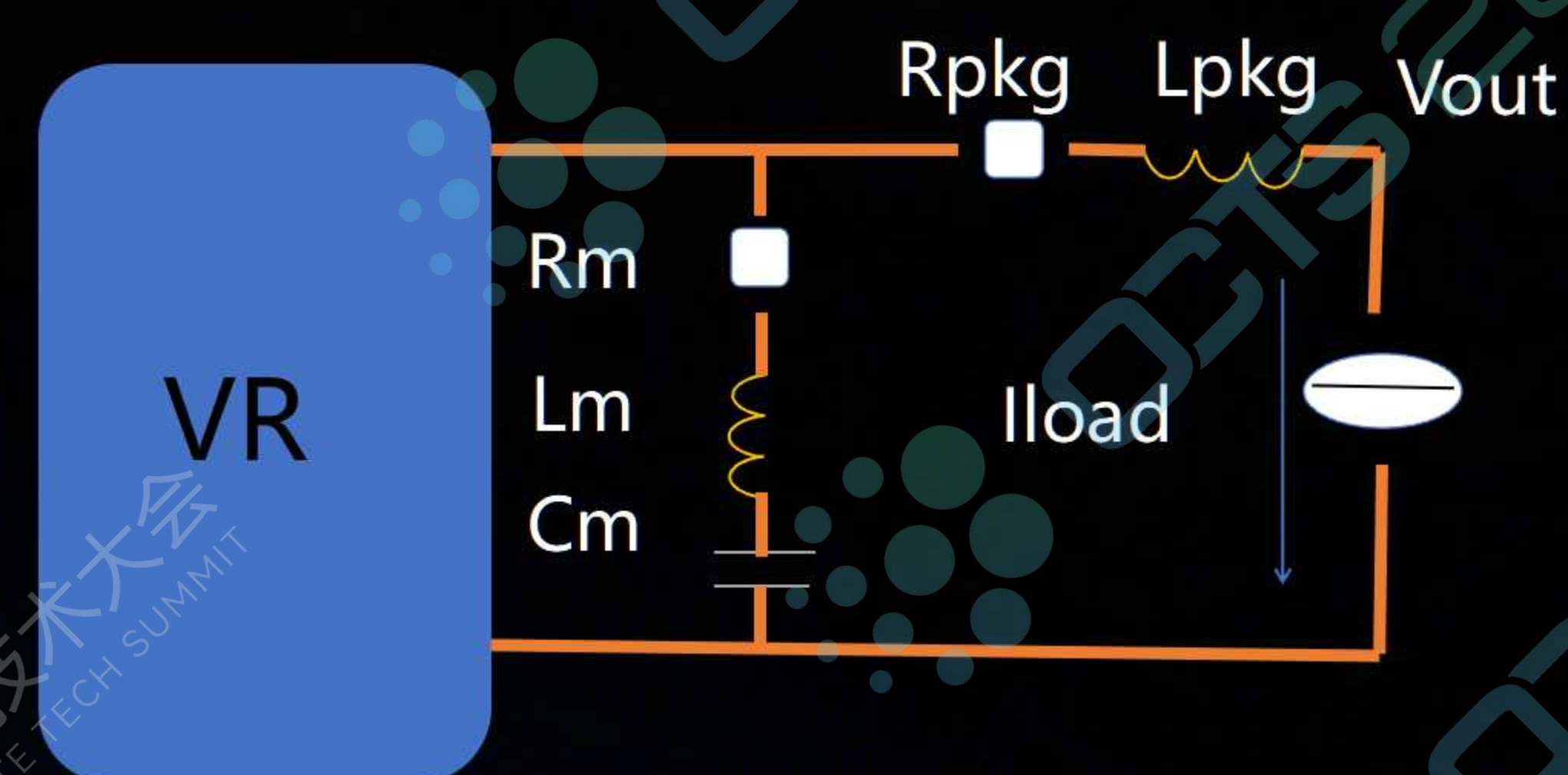


- GPU电流越来越大 (>2000A)
- Slew Rate越来越快

突然卸载过程



- 动态电流 I_{step} 越来越大
- 要求电压跌落 ΔV_0 更低



GPU Slew Rate: 10000A/us

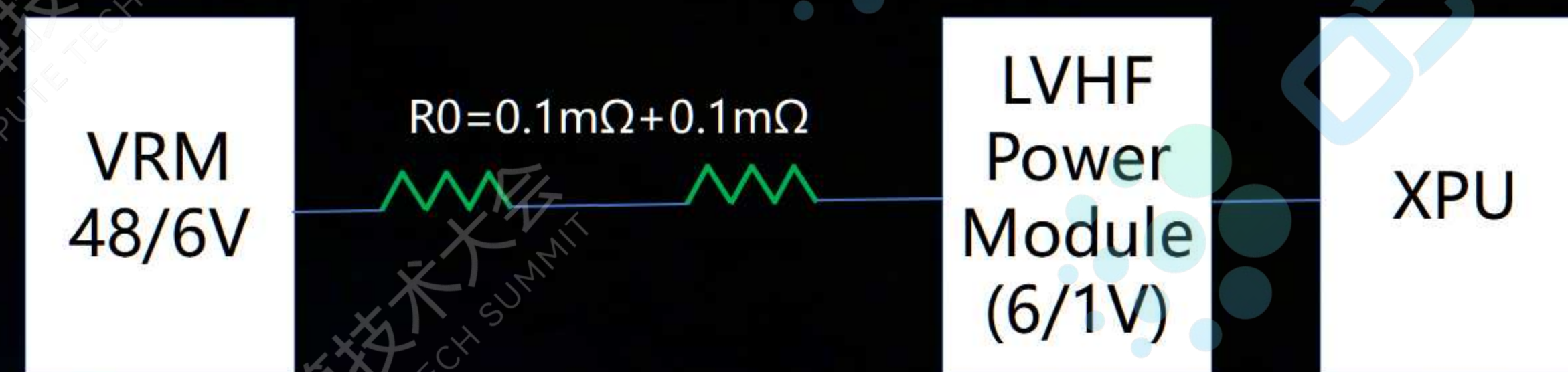
- L_{out} 电感量更小
- 需要更低的母线电压

2KW XPU效率收益对比

方案1：水平供电



方案2：垂直供电



方案1
VRM
48V/12 In
2727W

VRM 48V/12 Out
2672W
Output Current: 260A
Eff: 98%

Loss: 55W

R0 Loss: 5W

Loss: 267W

R1 Loss: 400W

XPU
Power
2000W

方案2
VRM
48V/6 In
2291W

VRM 48V/6 Out
2176W
Output Current: 365A
Eff: 95%

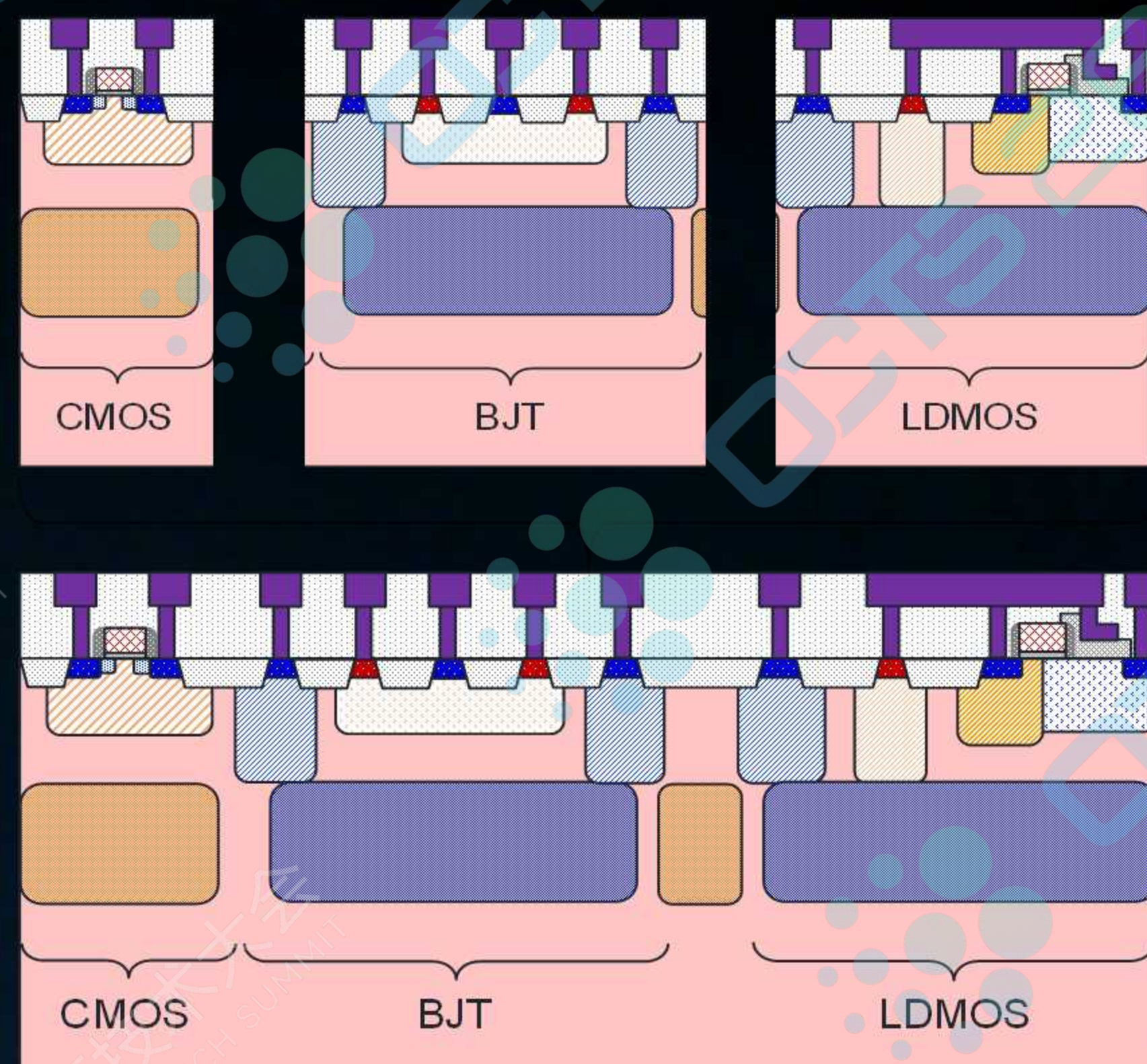
Loss: 115W

R0 Loss: 26W

Loss: 150W

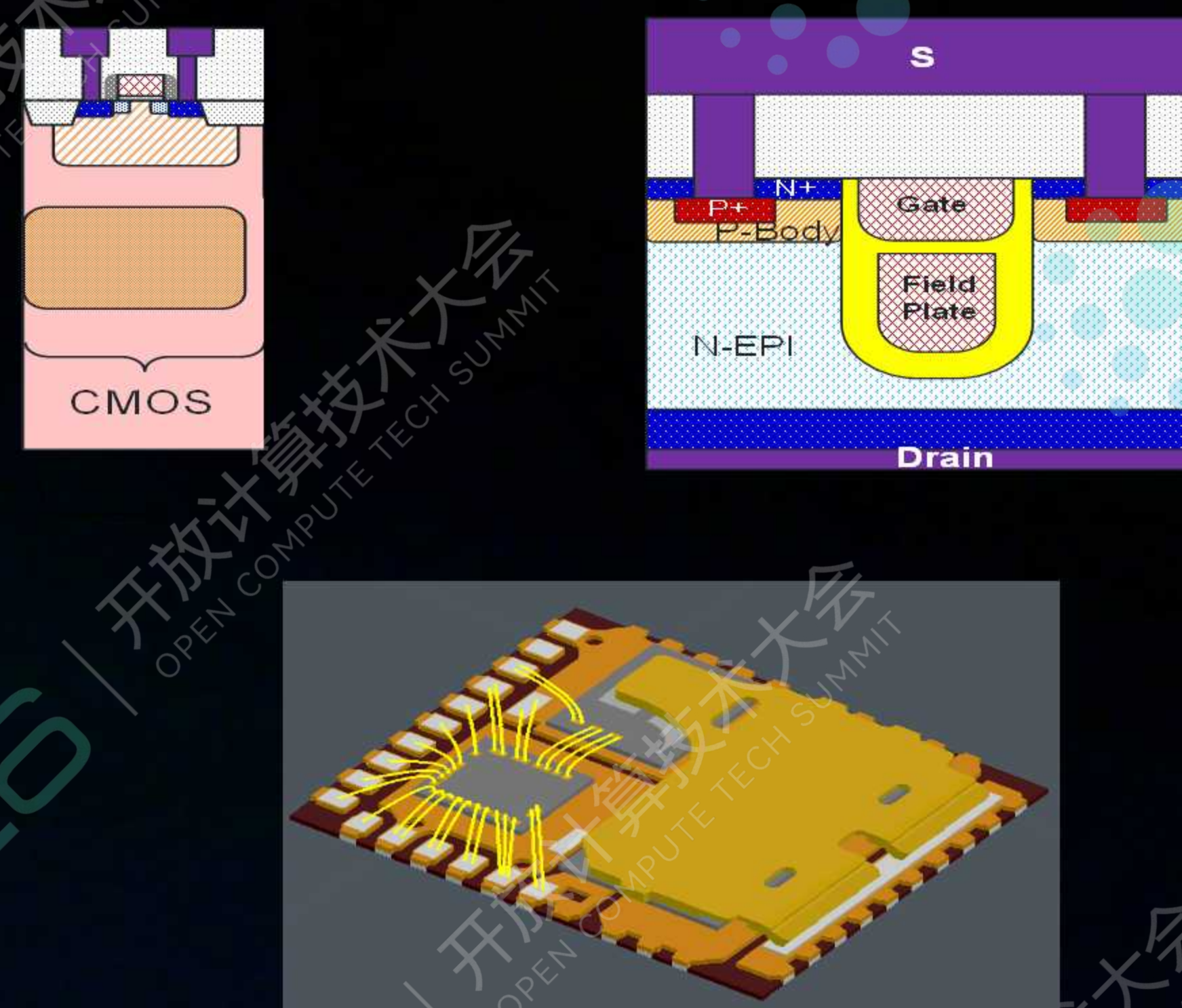
XPU
Power
2000W

长工微两条工艺路线



BCD工艺

大厂BCD工艺合作伙伴，多款大电流
Power Stage产品达到世界领先水平。

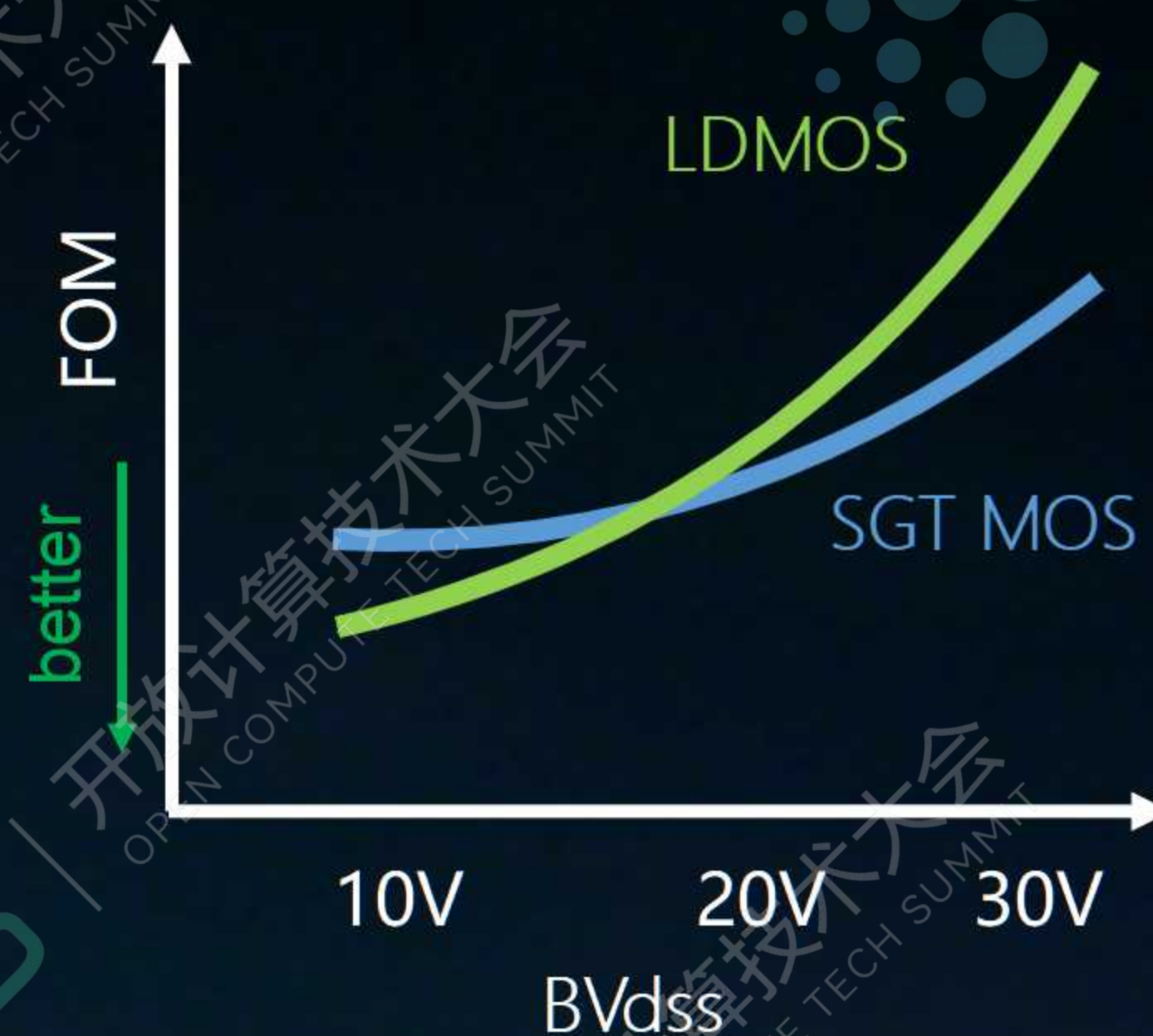


MCM工艺

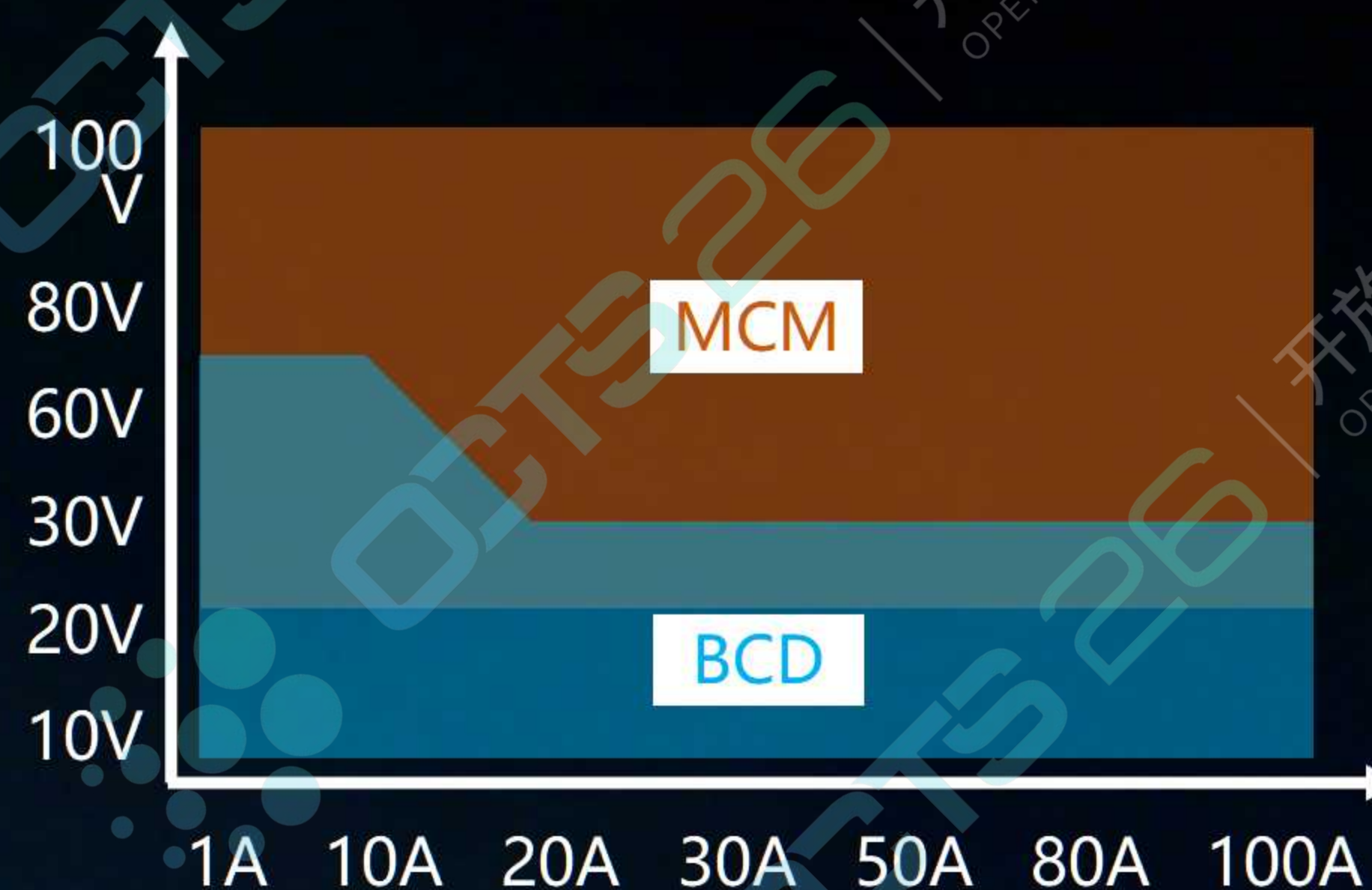
与国内外领先Trench MOSFET公司合作，定制
并量产多款MCM封装的Power Stage。

BCD工艺与MCM工艺的选择

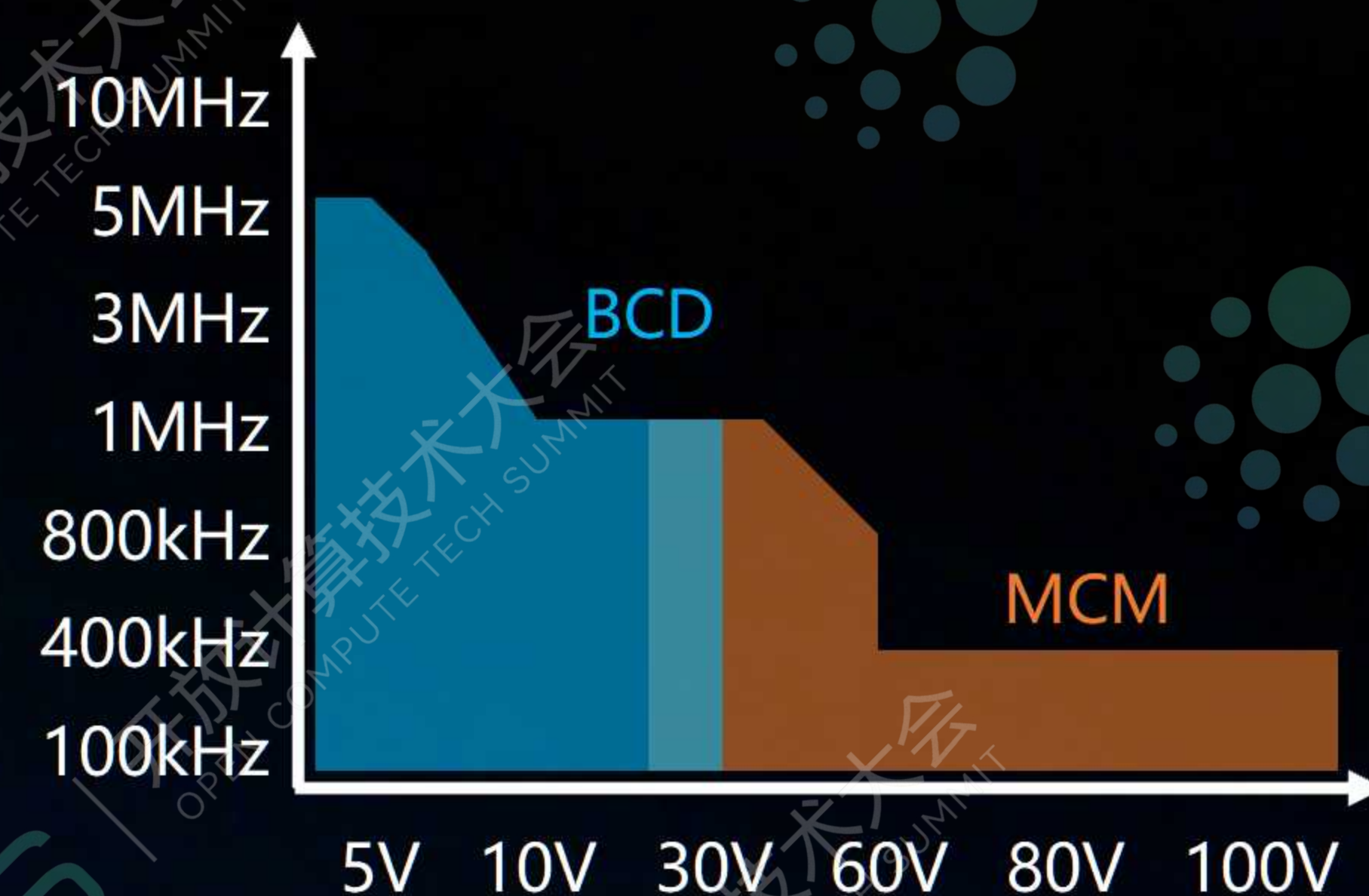
Figure-of-Merit
(FOM) 比较



最高工作区间的比较



开关频率的比较



- $V_{in} > 24V$: SGT MOS + 多芯片方案处于绝对优势
- $12V < V_{in} < 24V$: SGT MOS + 多芯片方案总体市占率更高(>80%), 但单芯片性能已接近多芯片方案, 且在小电流POL占比更高
- $V_{in} < 10V$: 低压LDMOS + 单芯片方案具有绝对优势

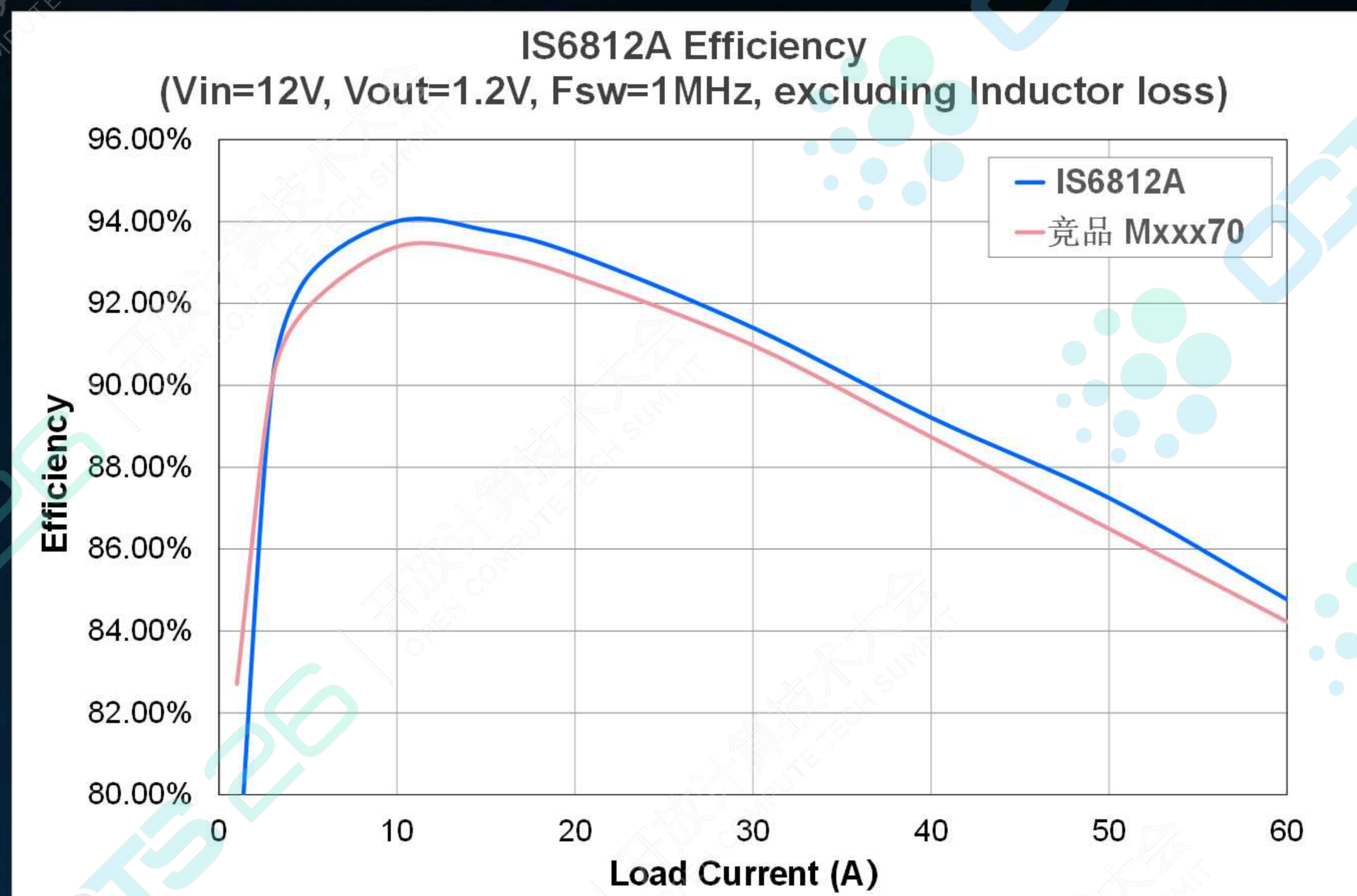
长工微客制化芯片工艺

集成功率芯片工艺	客制化*工艺开发流程	客制化*功率器件特性
- 基于BCD工艺，将CMOS数字单元、BJT模拟单元、LDMOS功率单元集成于同一芯片衬底 - 主流制程：8英寸180nm ~ 12英寸55nm节点	元件规格定义与结构设计 by 长工微* 工艺实验与工艺流程搭建 by FAB 元件性能测试与分析 by FAB 工艺可靠性及设计文件库 by FAB 芯片设计与流片验证 by 长工微*	长工微 vs. 竞争对手

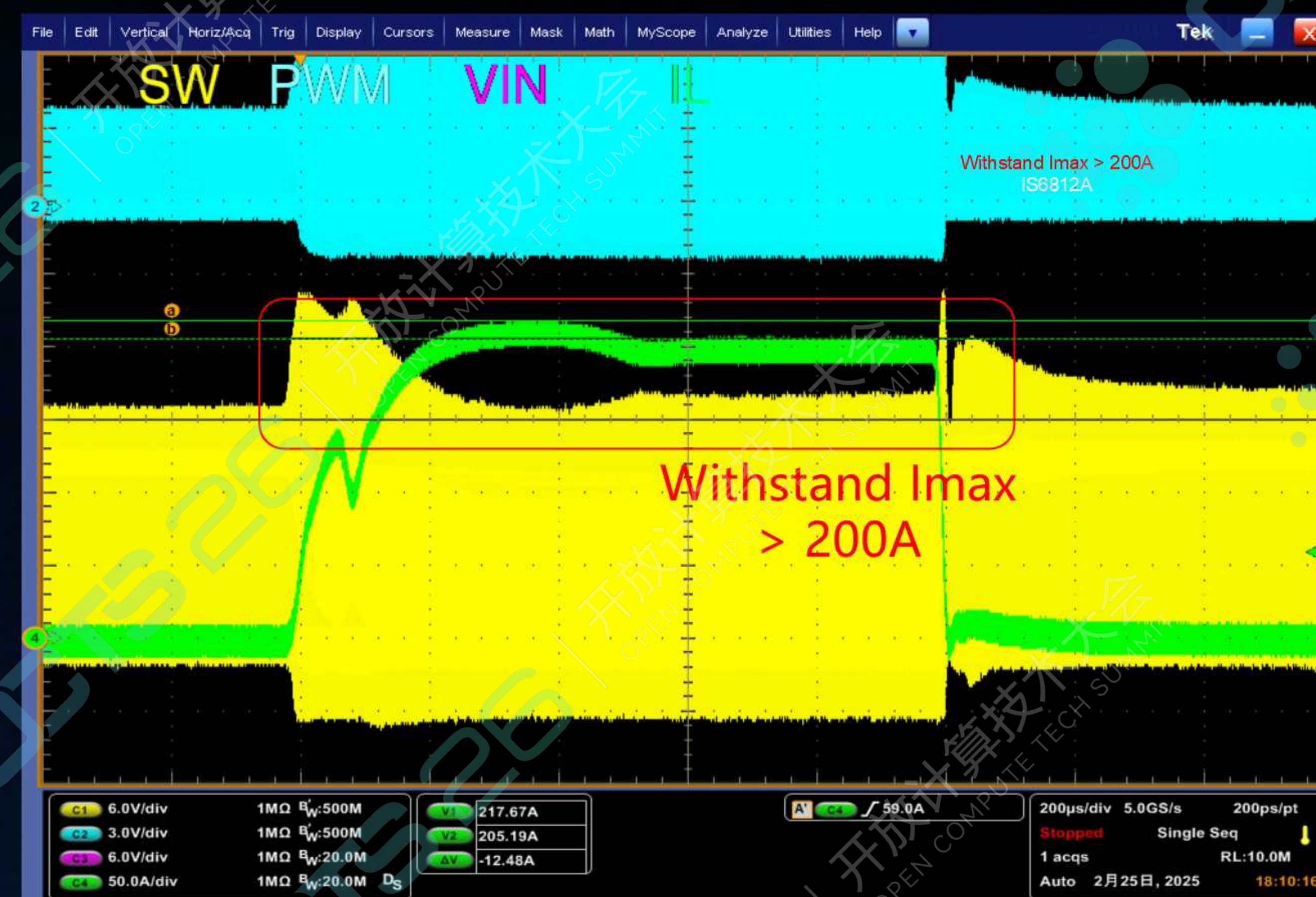
案例1：12V Vin Drmos产品特性

- 与Fab伙伴合作开发的12Vin大电流专用功率器件 (Rsp 12%↓, FOM 22%↓, UIS x15↑), 使芯片达到业界一流的转换效率、robustness、以及高良率!

优异的转换效率:
IS6812A (12V 70A DrMOS)

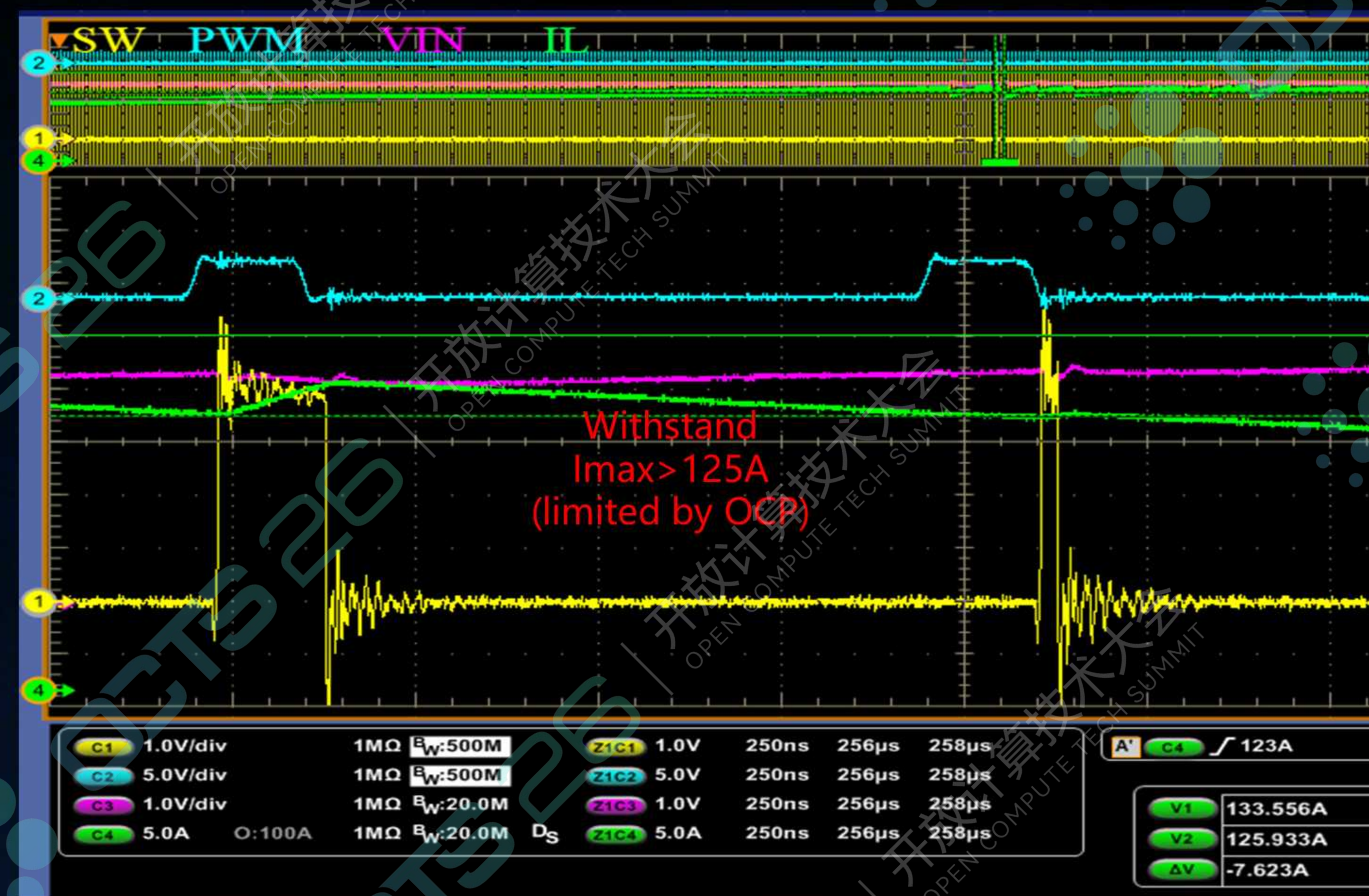
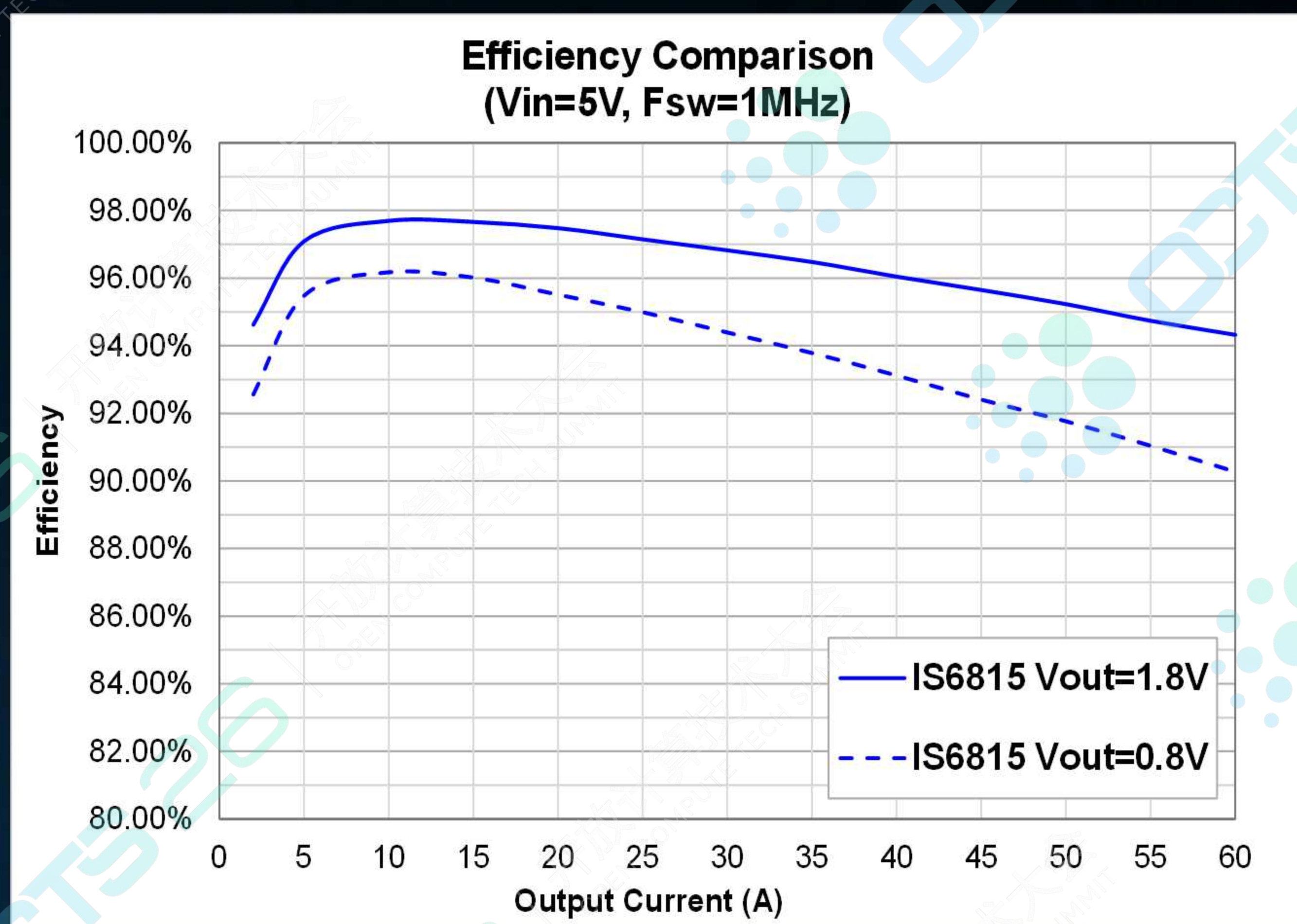


卓越的robustness:
IS6812A (12V 70A DrMOS)

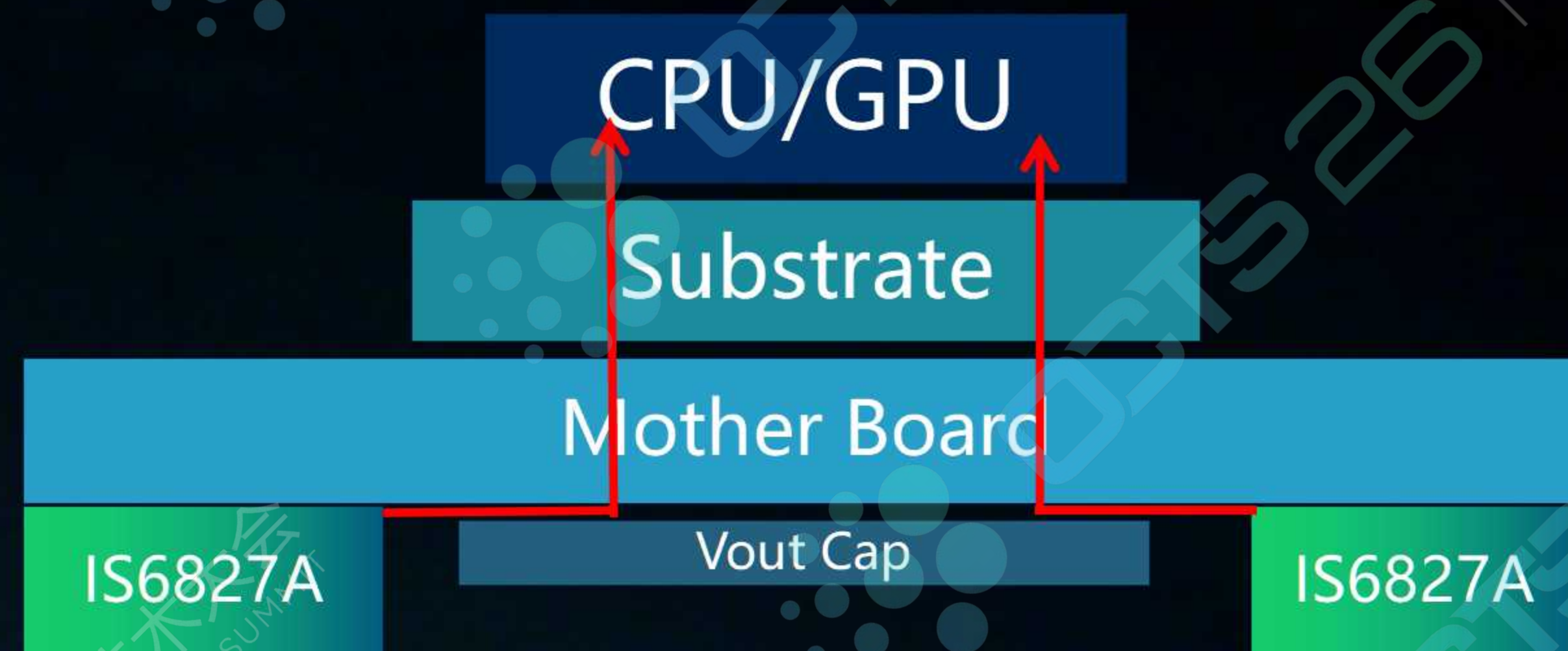


案例2：5V Vin Drmos产品特性

- 5V Vin PS IS6815A (Vin=5V, I_{max_tdc}=90A, 3mm*6mm, 单芯片集成)
- 主功率器件为长工微定制, UIS能力比标准5V功率管提升90倍, switching FOM优于25V分立MOS约30%以上



从水平供电到垂直供电



IS6827A Features

- Two phase smart power stage
- Wide 3V to 7.5V Input Voltage Range
- Works with Tri-State PWM Signal
- Current Monitoring and Temperature Reporting
- Operating **100KHz to 2MHz** Frequency
- Fault Reporting
- LGA 9.7x8.7mm Package

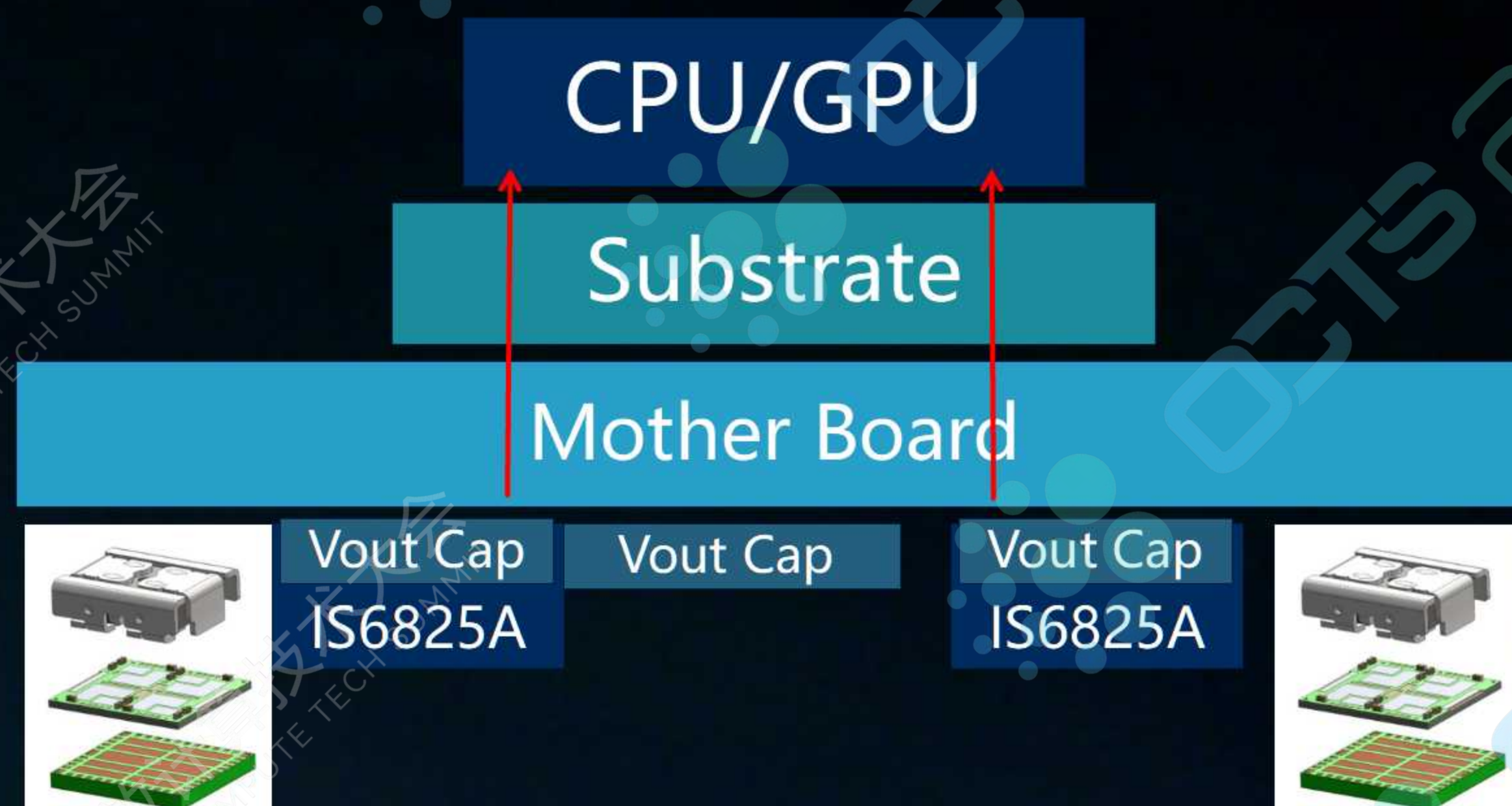
TOP VIEW

	1	2	3	4	5	6	7	8	9
A	PWM1	IMON1	EN1	TMON1	VCC	TMON2	EN2	IMON2	PWM2
B					VIN				
C									
D					GND				
E									
F									
G									
H									

VOUT1 is located at pin 4, and VOUT2 is located at pin 6.

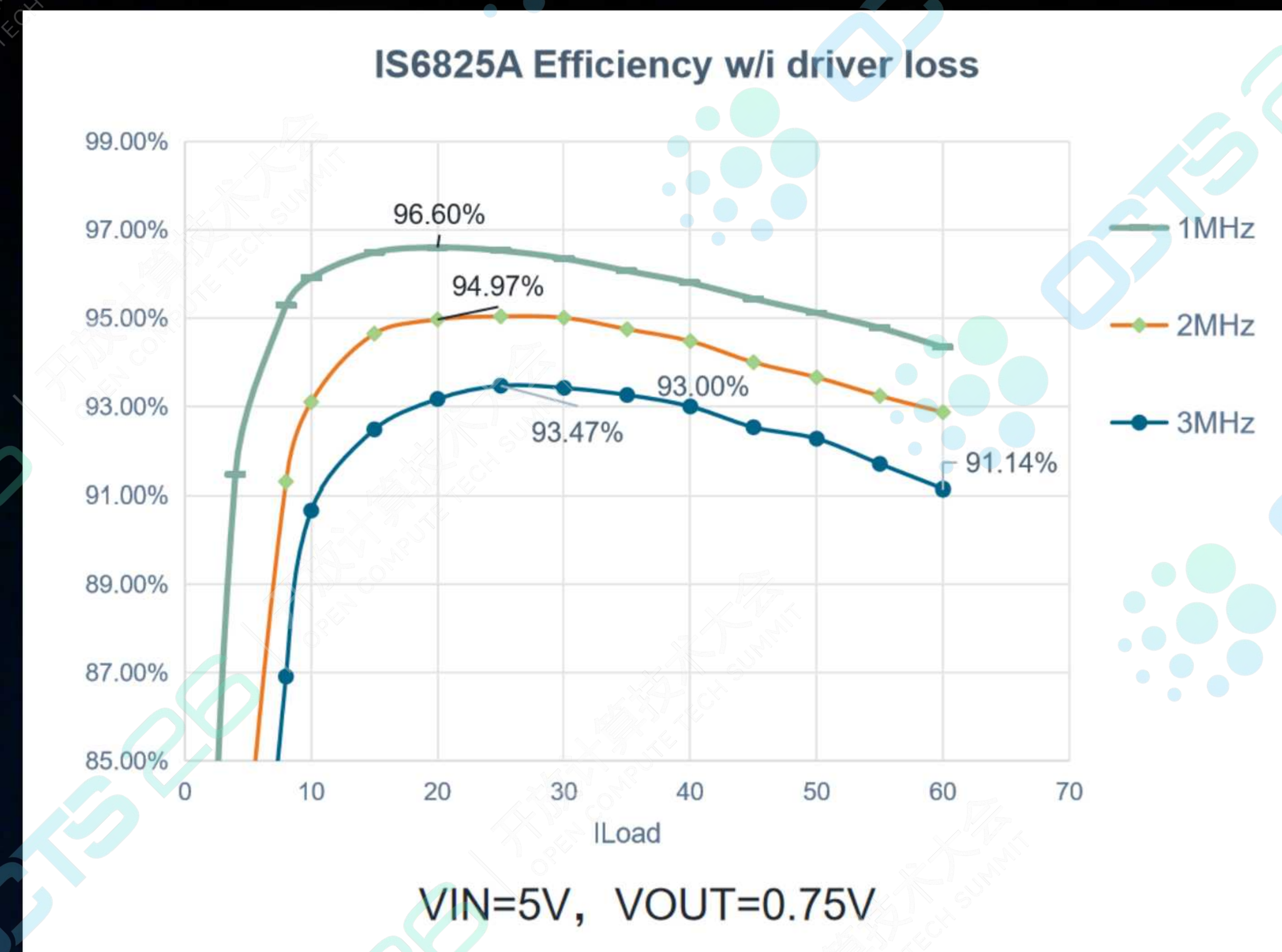


从水平供电到垂直供电

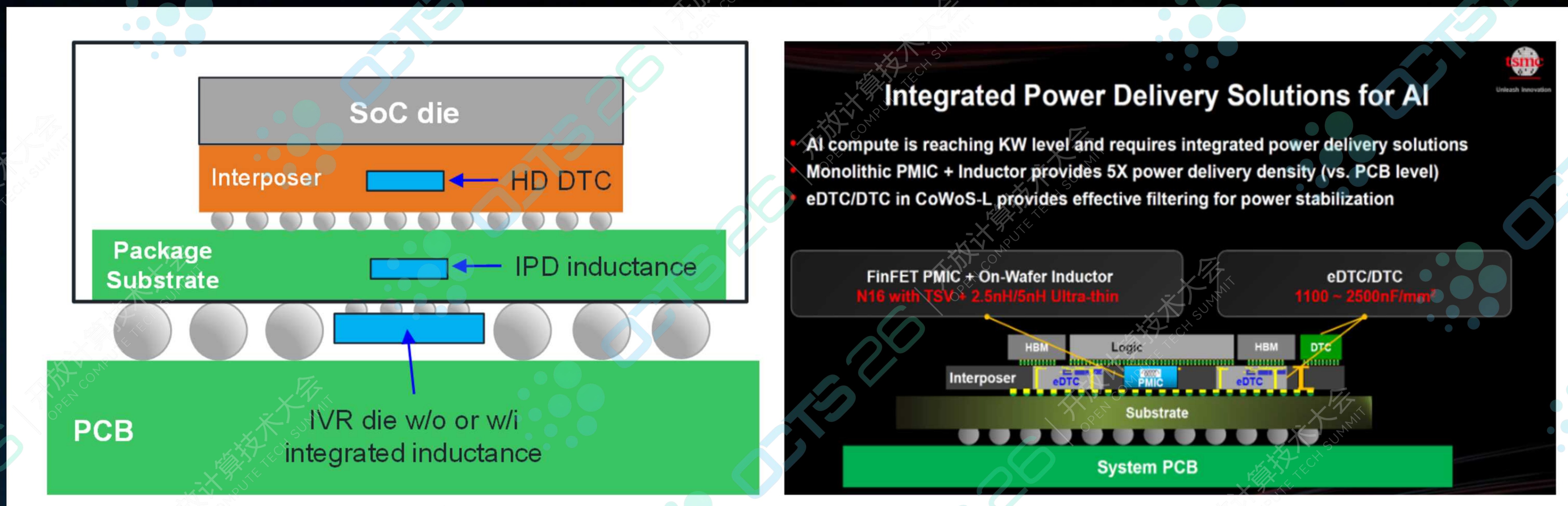


IS6825A Features

- Wide 2.5V to 6V Input Voltage Range
- Output DC current capability of 110A
- Works with Tri-State PWM Signal
- Current Monitoring and Temperature Reporting
- Operating **100KHz to 3MHz** Frequency
- Fault Reporting
- Built-In bootstrap switch

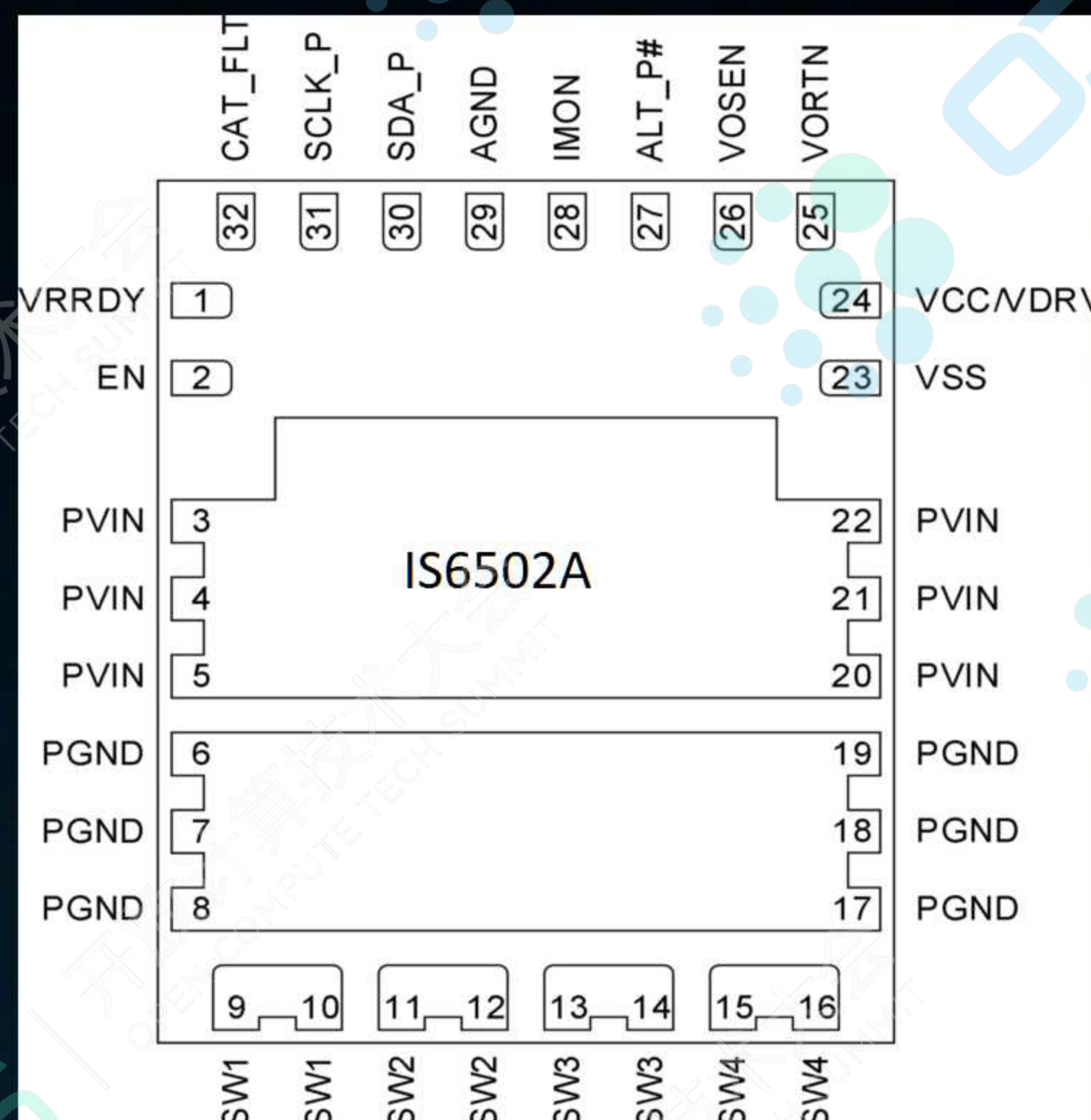


IVR——最后1mm



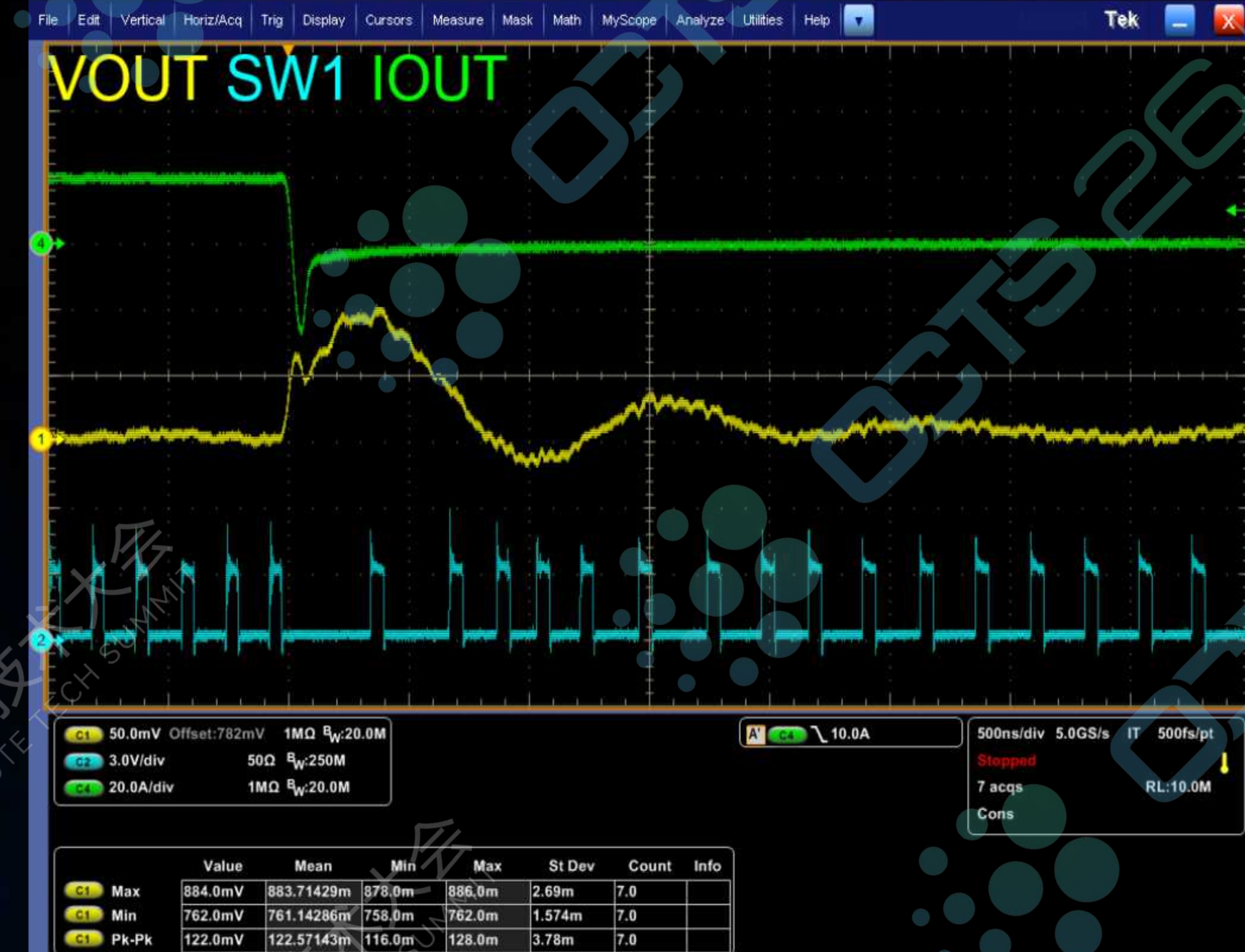
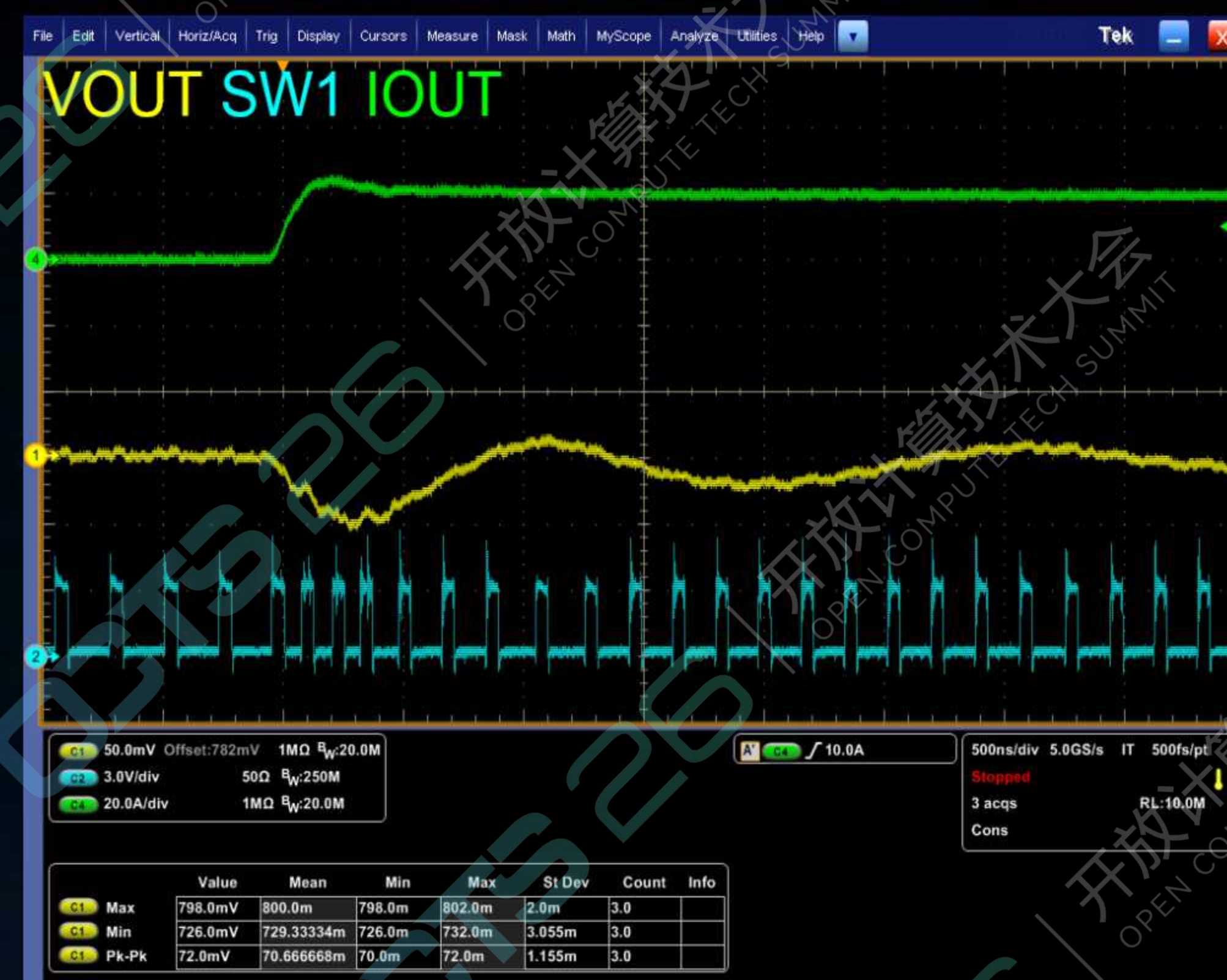
- ◆ IVR：低电压（ $\leq 3.3V$ ）、甚高频（ $> 10MHz$ ）、高功率密度、超薄供电架构，是解决XPU分区供电、优化动态能效的最优选择；
- ◆ 长工微已与Fab、电源模块及终端客户携手，启动相关项目的研发。

高频VR



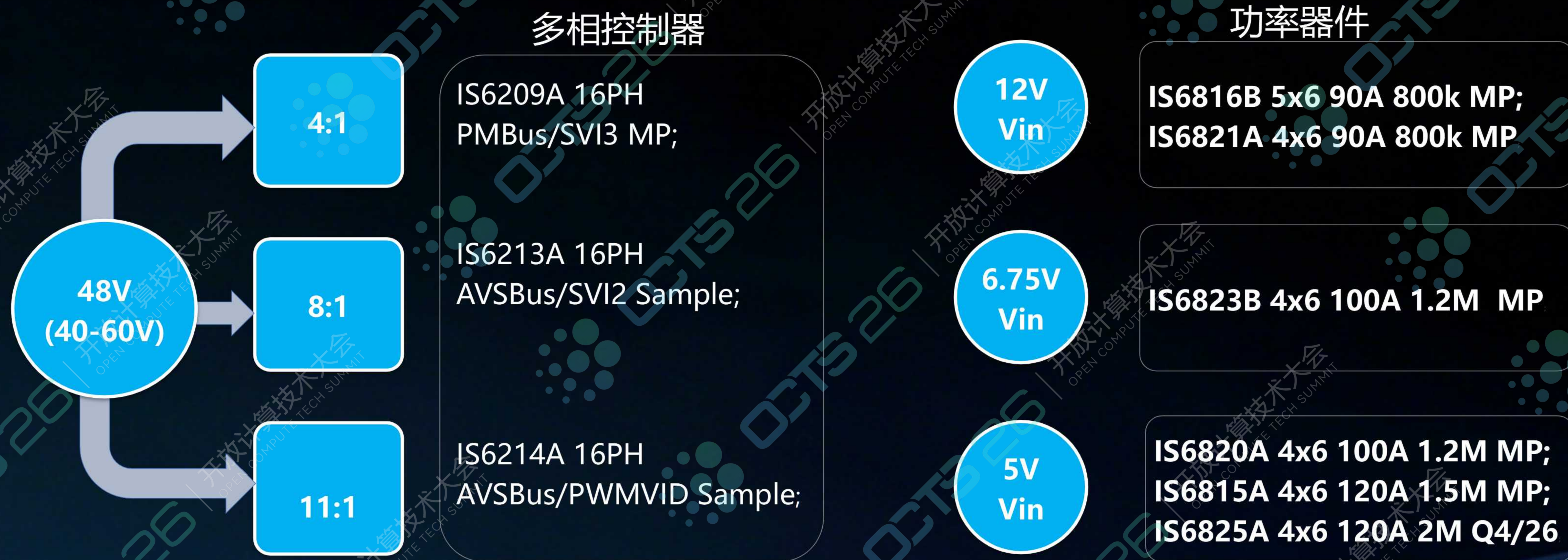
IS6502A Features

- 4 Phase High-frequency Voltage Regulator
- 2.5V to 5V Input Voltage Range
- 0.3V to 2.56V Output Voltage Range
- Switching frequency from **1MHz to 10MHz**
- Up to 50A EDC, 20A TDC
- I2C/SMBus/PMBus System Interface

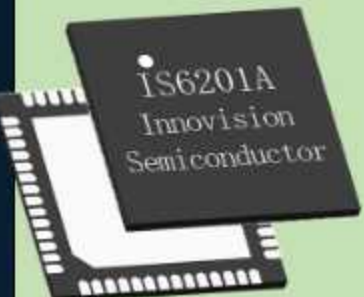


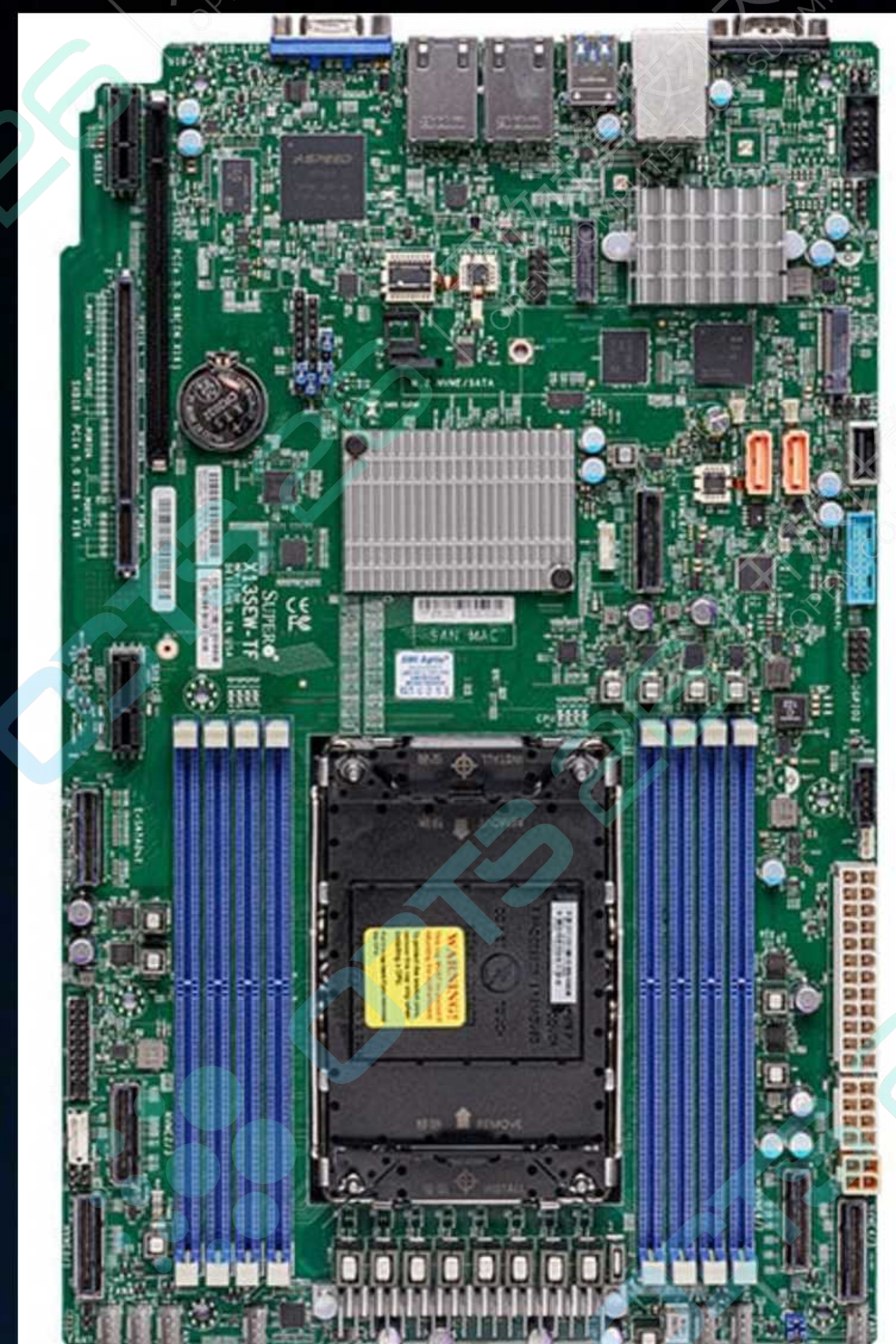
VIN=VCC=3.3V, VOUT=0.8V, L=20nH x4, Cin=602.4μF,
Cout=**66μF**, Fsw=**5MHz**
Load current (0~20A): SR_r=**160A/μs**, SR_f=**840A/μs**.

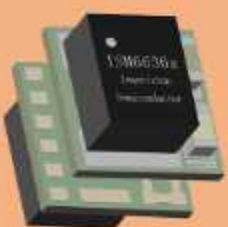
AI加速卡电源VRM全覆盖



长工微现有产品系列

	POL Converter IS6605A/H, IS66066/H, IS6607A, IS6607H, IS6608A, IS6609A, IS6620A, IS6630A, IS6631A, IS6302A, IS6615A/B ...
	Power Stage IS6805A, IS6806A/C, IS6809A, IS6811A, IS6815A/B, IS6816A/B, IS6819A, IS6820A, IS6821A, IS6812A, IS6823A, IS6826A/B, IS6828x...
	Multi-phase Controller IS6201A, IS6202A, IS6204A, IS6205A, IS6206A, IS6207A, IS6209A, IS6210A, IS6212A/B, IS6213A, IS6214A...



	Power Module ISM6401A, ISM6402B, ISM6405A, ISM6636x, ISM6404A, ISM6406A/B...
	Hot Swap/Efuse IS6102A, IS6103A/B/C/D IS6105A, IS6108A/B/C



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