



WT MICROELECTRONICS

文暉科技 股份有限公司

双有源桥直流变换器助力V2G/L应用



文暉科技
WT MICROELECTRONICS

光储充为应用的主要场景

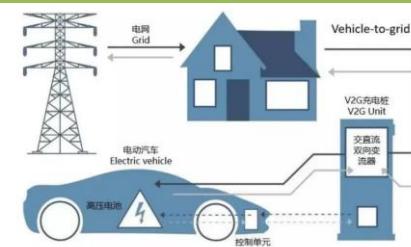
可再生能源系统



储能系统



电动汽车



DAB

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DAB的变压器设计

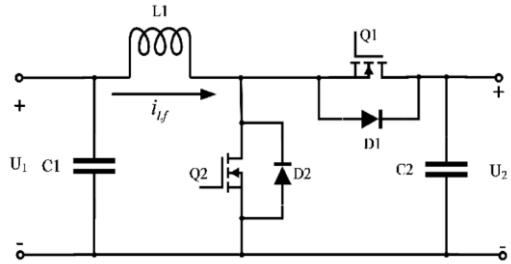
6

总结

双向DC-DC中常见的拓扑

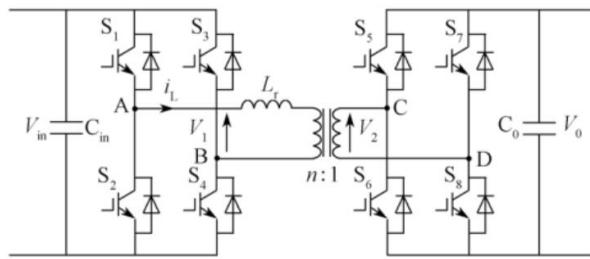
小功率

双向Buck-Boost

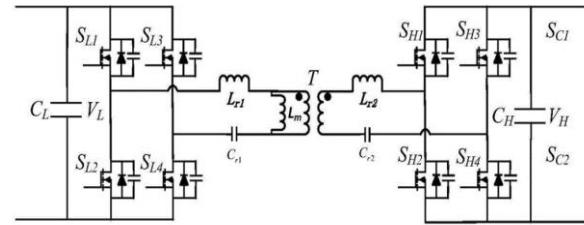


中大功率

DAB

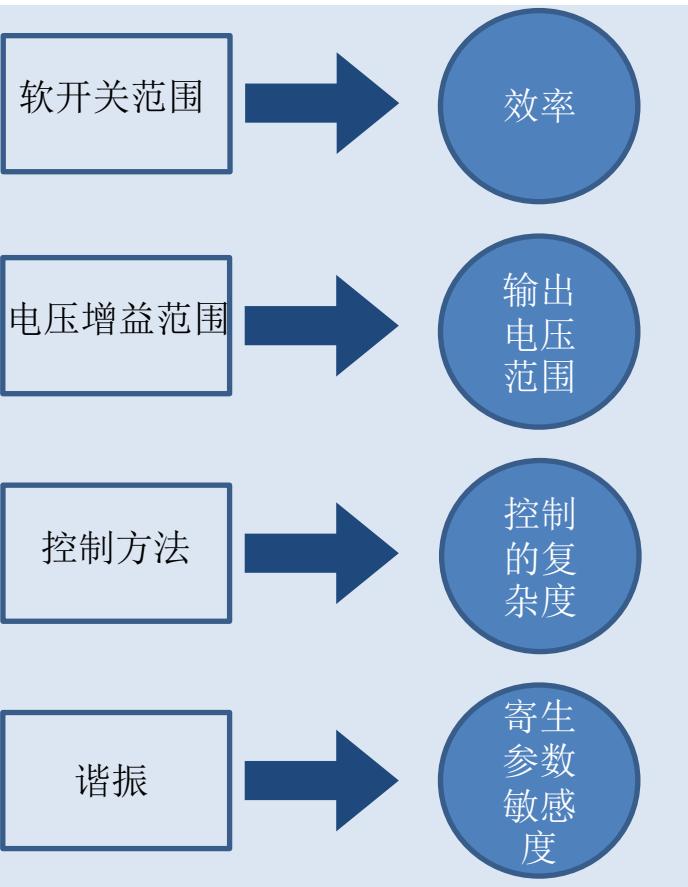
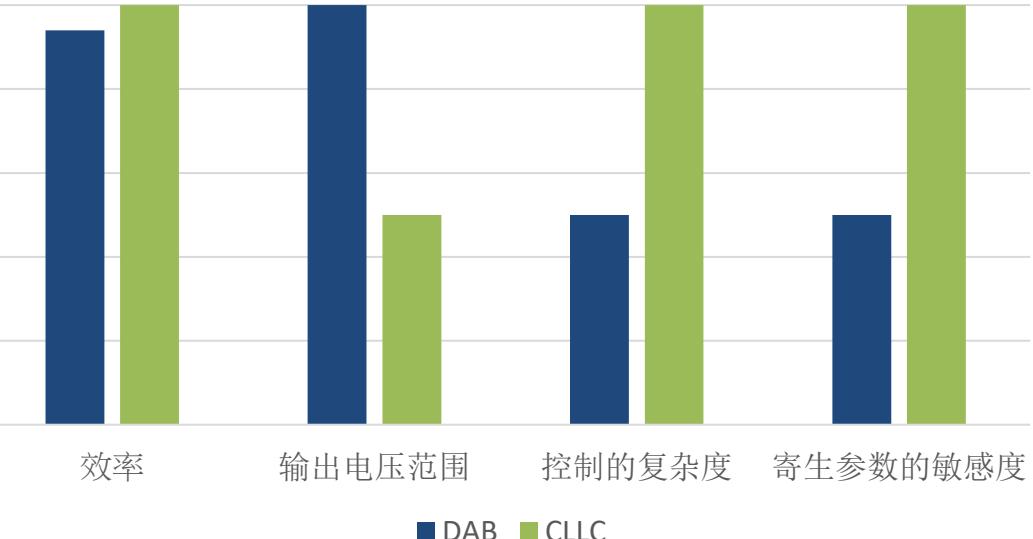


CLLC



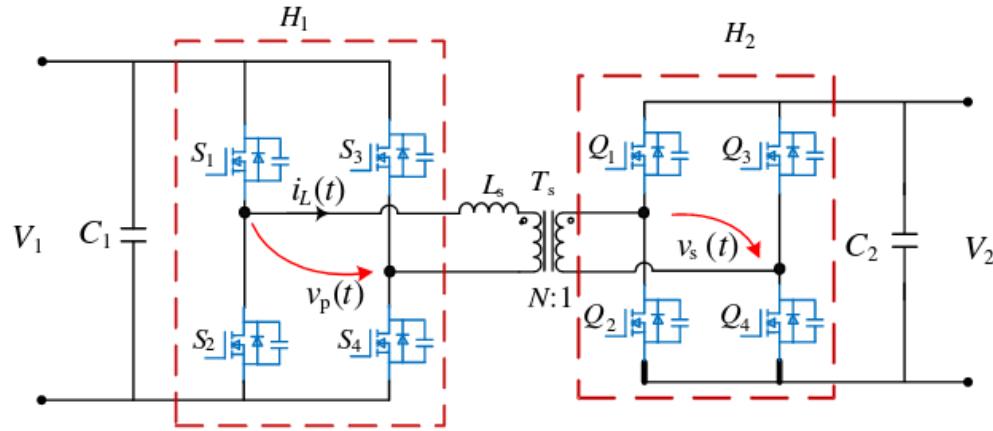
双向直流变换器中DAB的优势

DAB VS CLLC



DAB的工作原理

DAB的基本结构



原边全桥

高频变压器

传输电感

副边全桥

滤波电容

DAB的工作原理

DAB的模态分析

例：单移相控制 ($D_0 > 0$, 正向传输)

$[0, t_0]$: 电感放电

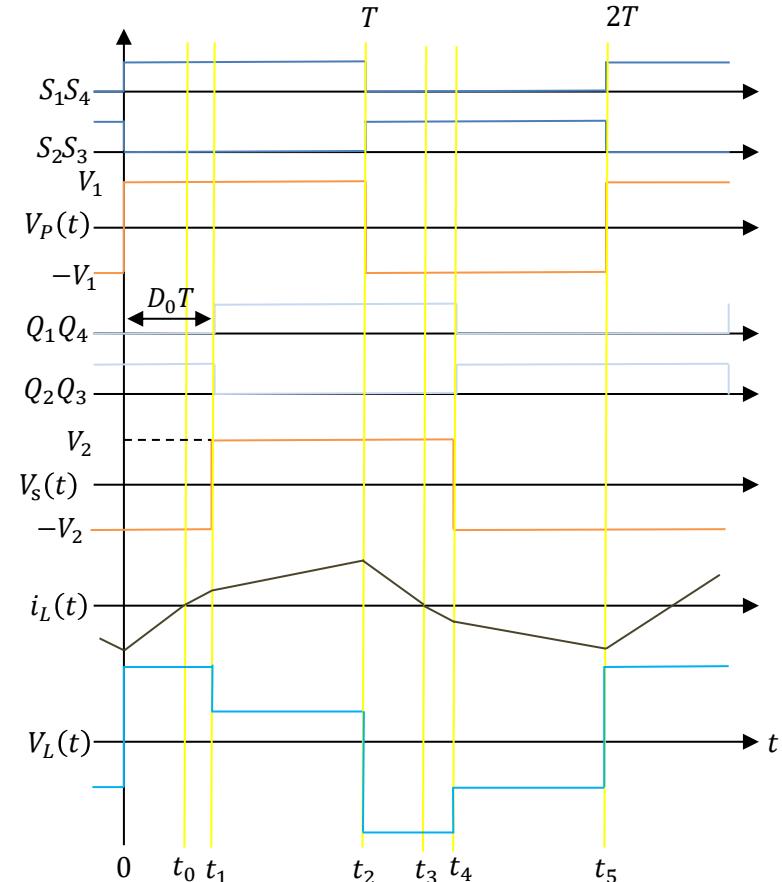
$[t_0, t_1]$: 电感正向充电, 实现ZVS

$[t_1, t_2]$: 电感正向电流上升速度减小

$[t_2, t_3]$: 电感反向充电

$[t_3, t_4]$: 实现ZVS

$[t_4, t_5]$: 电感反向电流上升速度减小

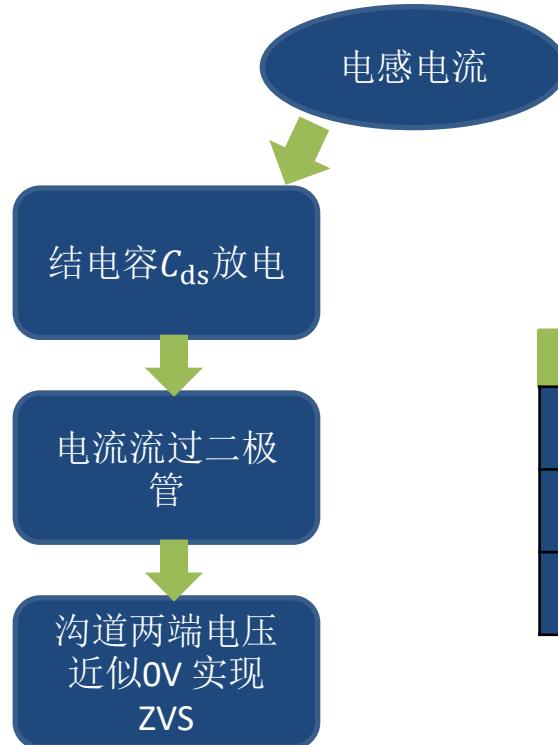
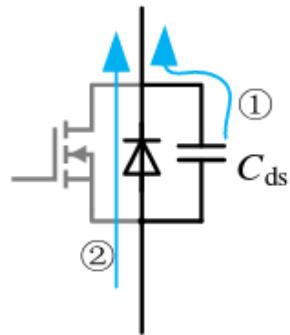


DAB的工作原理

DAB的ZVS分析

ZVS: 零电压导通

例: S_1



各开关器件实现ZVS的电流条件

开关器件	电流方向
$S_1 S_4 Q_2 Q_3$	$i_L < 0$
$S_2 S_3 Q_1 Q_4$	$i_L > 0$

DAB的变压器设计

DAB变压器的特点

- 高功率密度
- 高频性
- 集成性



DAB变压器的选型

- 绕线式变压器
- 铁氧体材料
- 变压器漏感

DAB的变压器设计

变压器匝数比计算

$$N = \frac{\sqrt{V_{1,max} \times V_{1,min}}}{\sqrt{V_{2,max} \times V_{2,min}}}$$

N: 匝数比

$V_{1,max}$:原边电压最大值

$V_{1,min}$: 原边电压最小值

$V_{2,max}$:副边电压最大值

$V_{2,min}$:副边电压最小值



功率电感传输计算

$$L = \frac{nV_1V_2}{2Pf_s} D_0(1 - D_0)$$

L:电感值

n:匝数比

V_1 :原边电压

V_2 :副边电压

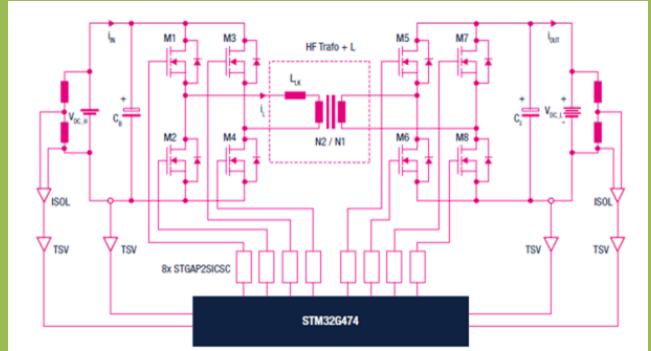
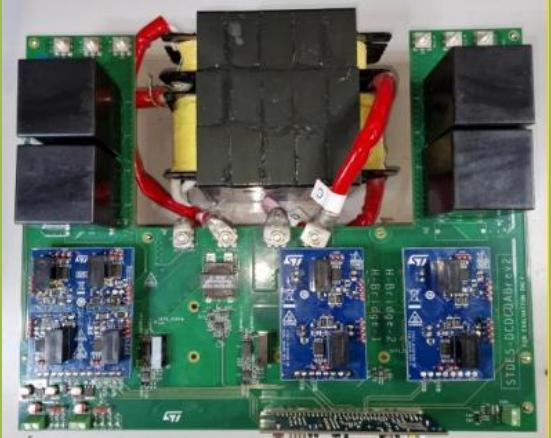
D_0 :占空比

P: 功率

f_s :开关频率



ST 25kw DAB



主要特点:

输入电压: 800V(720V-880V)
输出电压: 250V-500V
输出功率: 25kW
峰值效率: >98%
开关频率: 100kHz



关键产品:

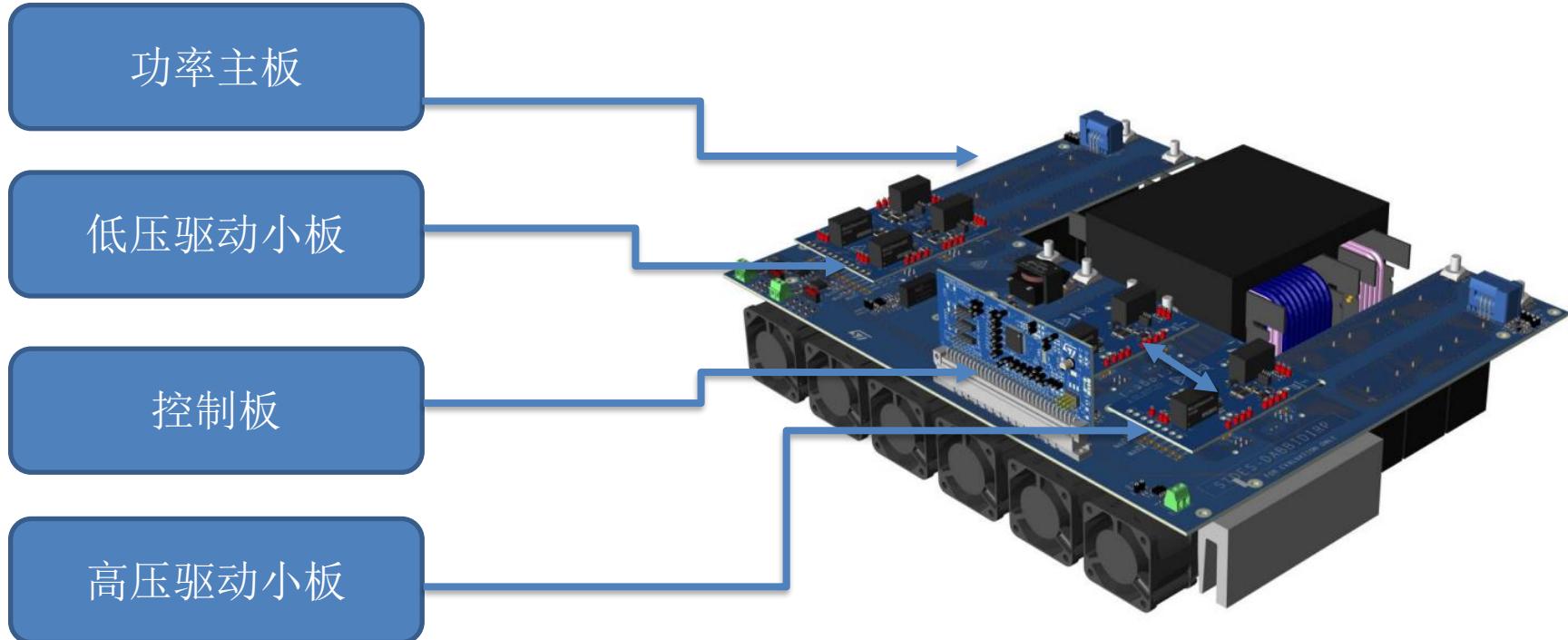
A2F12M12W2-F1
A2H6M12W3-F
STGAP2SICS
STM32G474

关键优势:

基于SiC模块和全数字控制实现双向DC/DC
拓扑采用的是双有源桥直流变换器—DAB

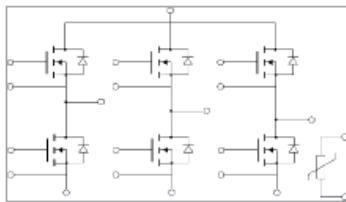


ST 25kw DAB



ST SiC Mosfet Moduel

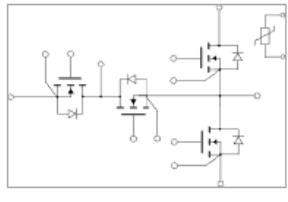
种类



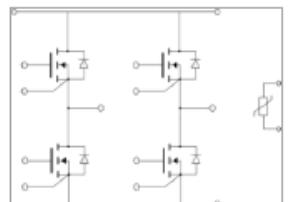
Six-Pack



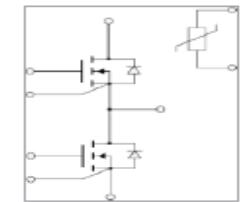
A1P25M12W2-1



Three Level



Four Pack



Half Bridge

Q4-2022



A1F25M12W2-F1

12mΩ

A1H12M12W2-F

6mΩ

A2H6M12W3-F

Q3-2022



A1P18M65W2-1

18mΩ

ACEPACK 1

33.8 x 48 mm



ACEPACK 2

48 x 56.7 mm



A2U12M12W2-F1C

12mΩ

A2U12M12W2-F2



A2F12M12W2-F1

Released

● BV=1200V

● BV=650V

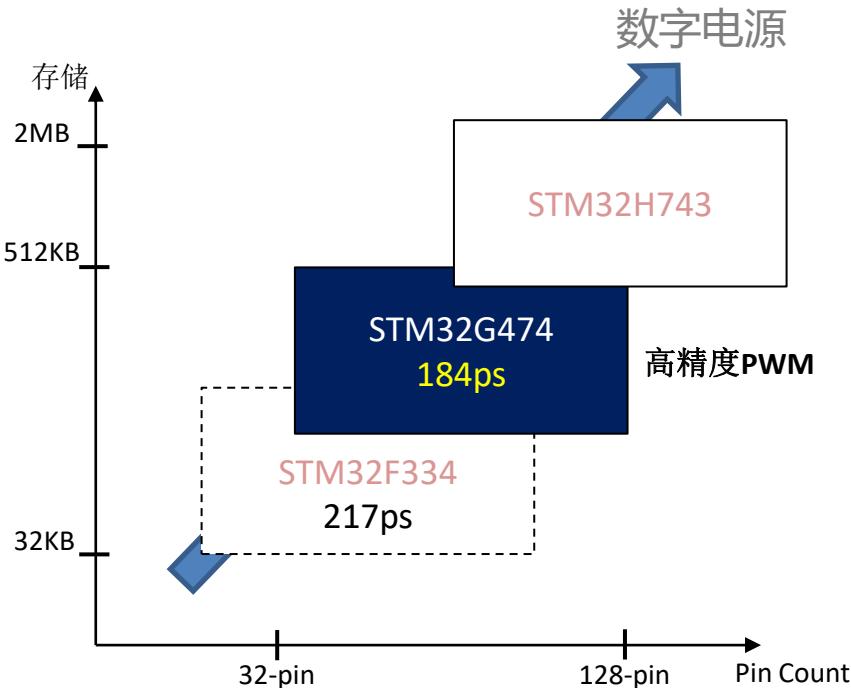
● ACEPACK 2

● ACEPACK 1

STM32 MCU



STM32数字电源平台



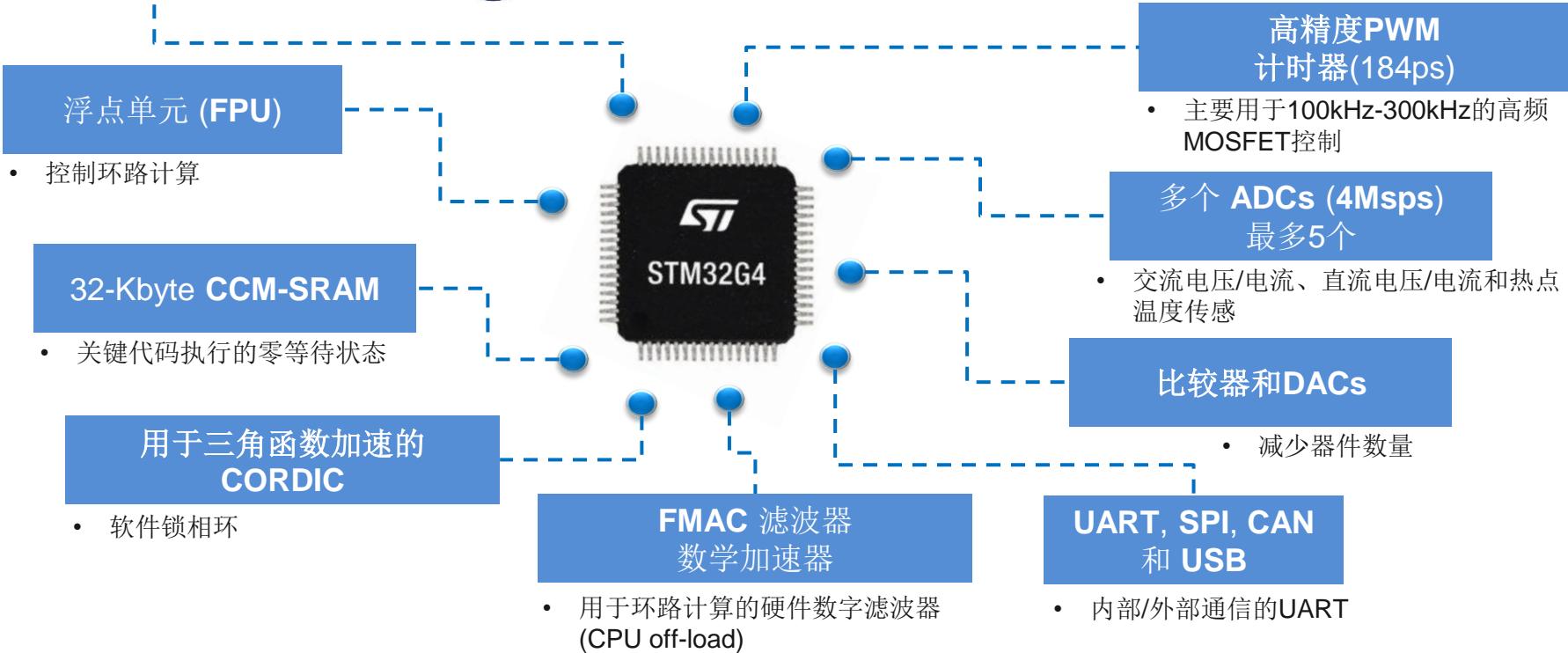
STM32G474
ADC +MCU(170MHz) +PWM

STM32H743
ADC +MCU(480MHz) +PWM

高达170MHz Arm®
Cortex® -M4



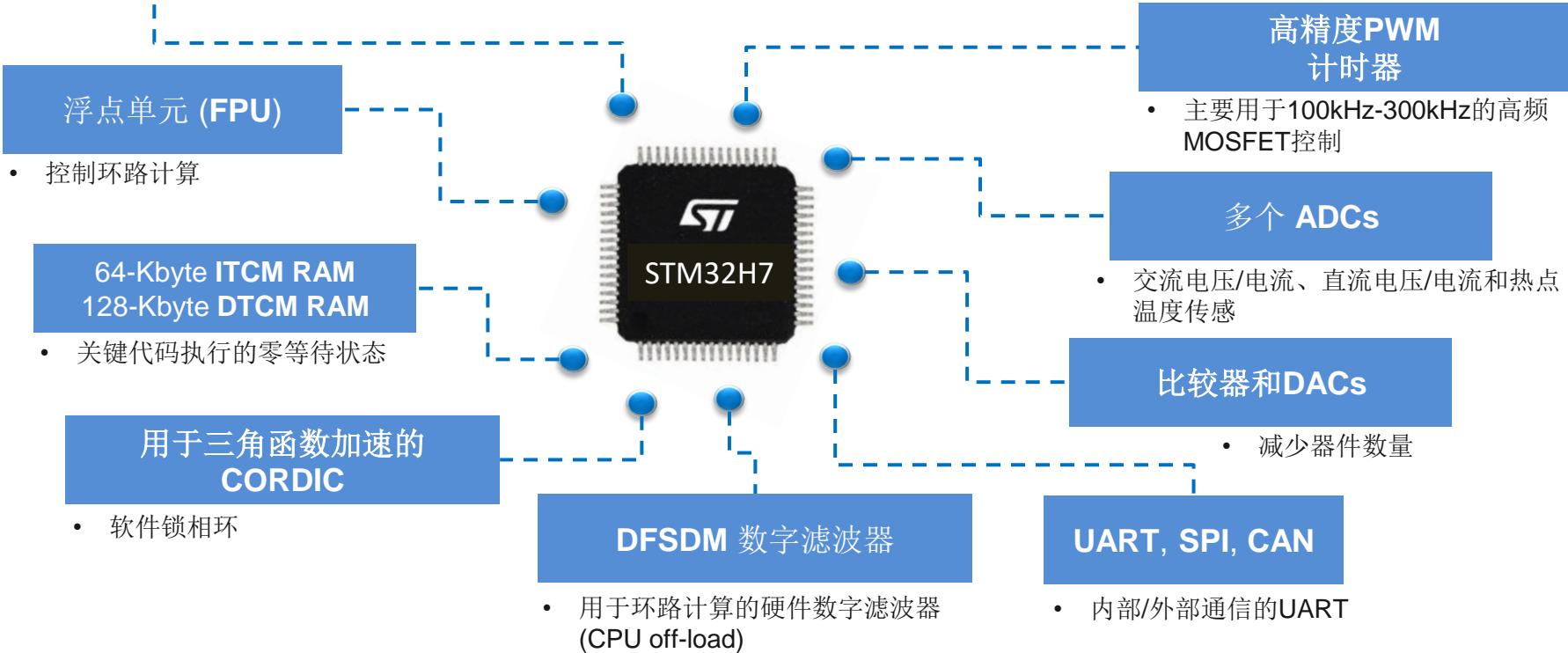
Configurations of MCU key functions



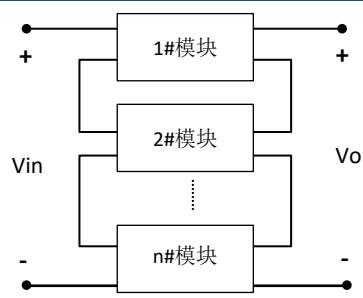
高达480MHz Arm®
Cortex® -M7



Configurations of MCU key functions

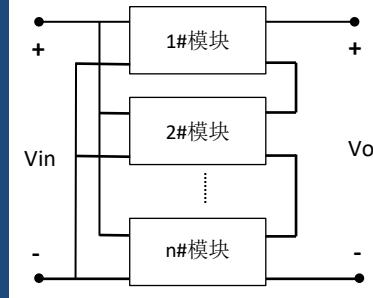


50kw DAB 如何实现



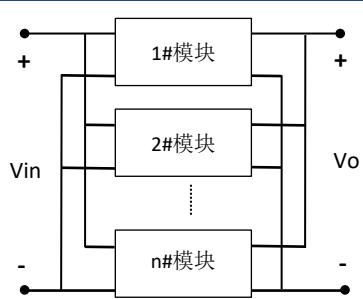
ISOS

输入串联输出串联
应用场景：
高压电源、新能源发电、
高铁等高电压场合



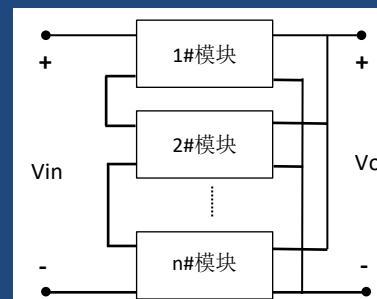
IPOS

输入并联输出串联
应用场景：
太阳能光伏发电、燃料电池等场合



IPOP

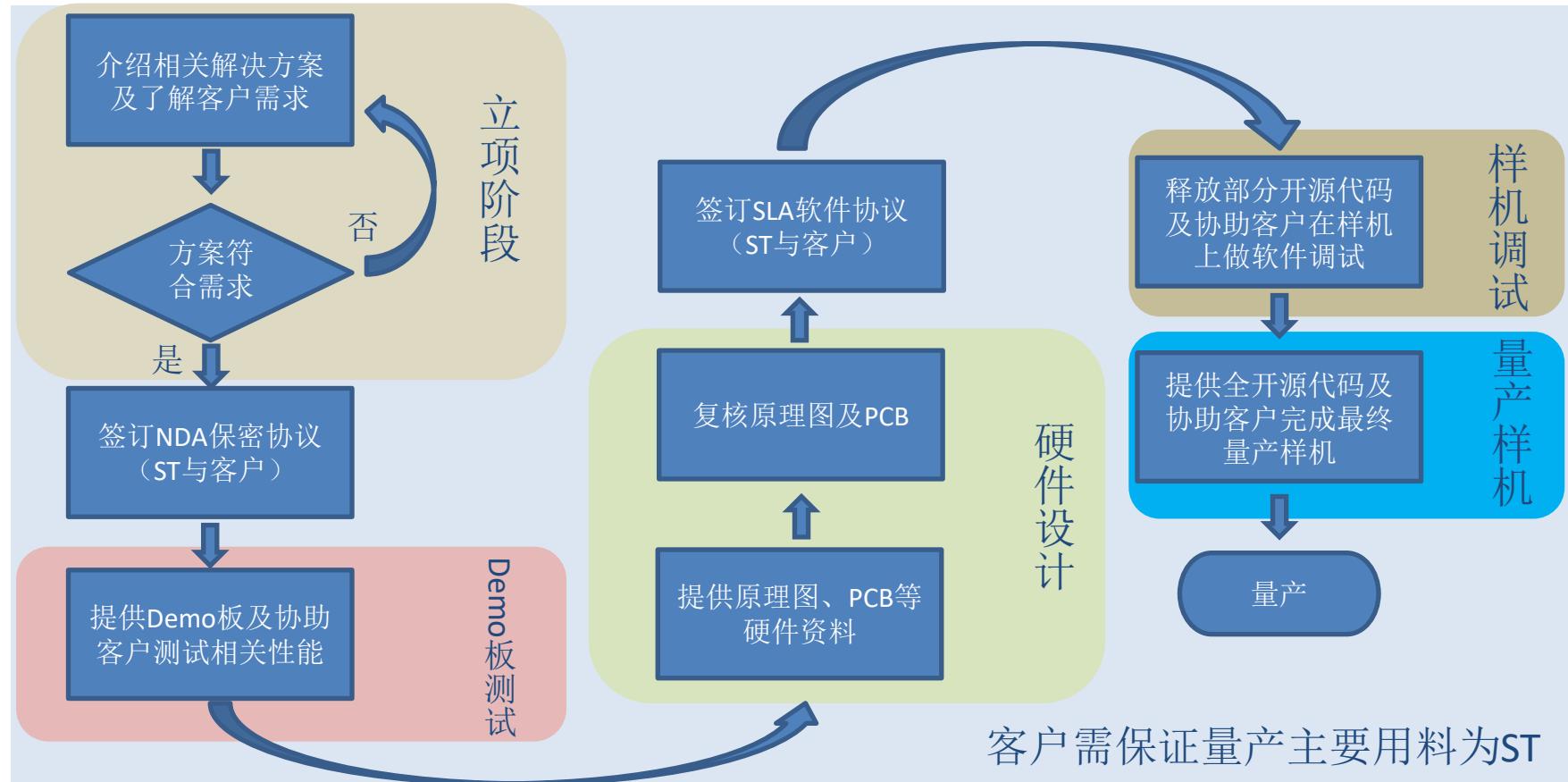
输入并联输出并联
应用场景：
多相Buck等结构较为简单的电路



ISOP

输入串联输出并联
应用场景：
高压直流微网、电动汽车
充电

关于解决方案如何去支持客户



总结

DAB在双向直流变换器的优势

关于ST 25kw DAB解决方案

ST在此应用中的优势产品

关于ST的解决方案如何去支持客户

2024



文晔科技

与您同行