

CoolSiC™ JFET: 固态配电的核心动力

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Traditional Circuit Breaker Types 传统低压电器主要类型



- ACB (Air Circuit Breaker)
 - ✓ Use compressed air to quench the arc;
 - ✓ Nominal current > 250A



- MCCB (Molded Case Circuit Breaker)
 - ✓ Nominal current > 125A



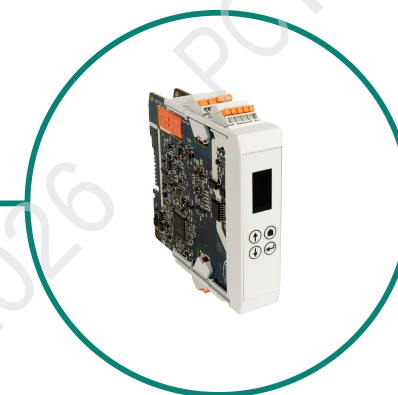
- MCB (Miniature Circuit Breaker)
 - ✓ Nominal current < 125A



- Relay

Power distribution going smart 配电智能化

Smart circuit breakers integrate multiple functions into one single device



Smart circuit breakers integrate multiple functions into one single device

Encompasses a wide range of components adapted to specific system requirements

Compact, reliable, and cost-effective solid-state solution

These applications primarily require smart power distribution

固态配电的潜在应用场景——汽车、工业和计算



SSCBs, PDU Hotswap



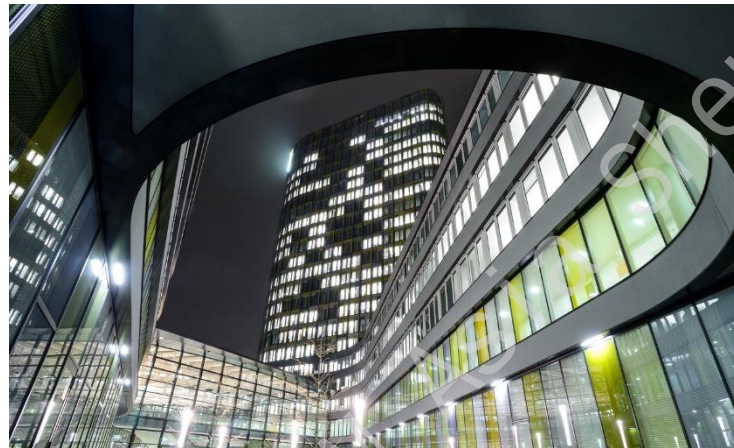
SSCBs, DC Breakers



SSCBs, DC Breakers, Microgrid Sync



SSCBs, DC Breakers, Motor Soft Starters



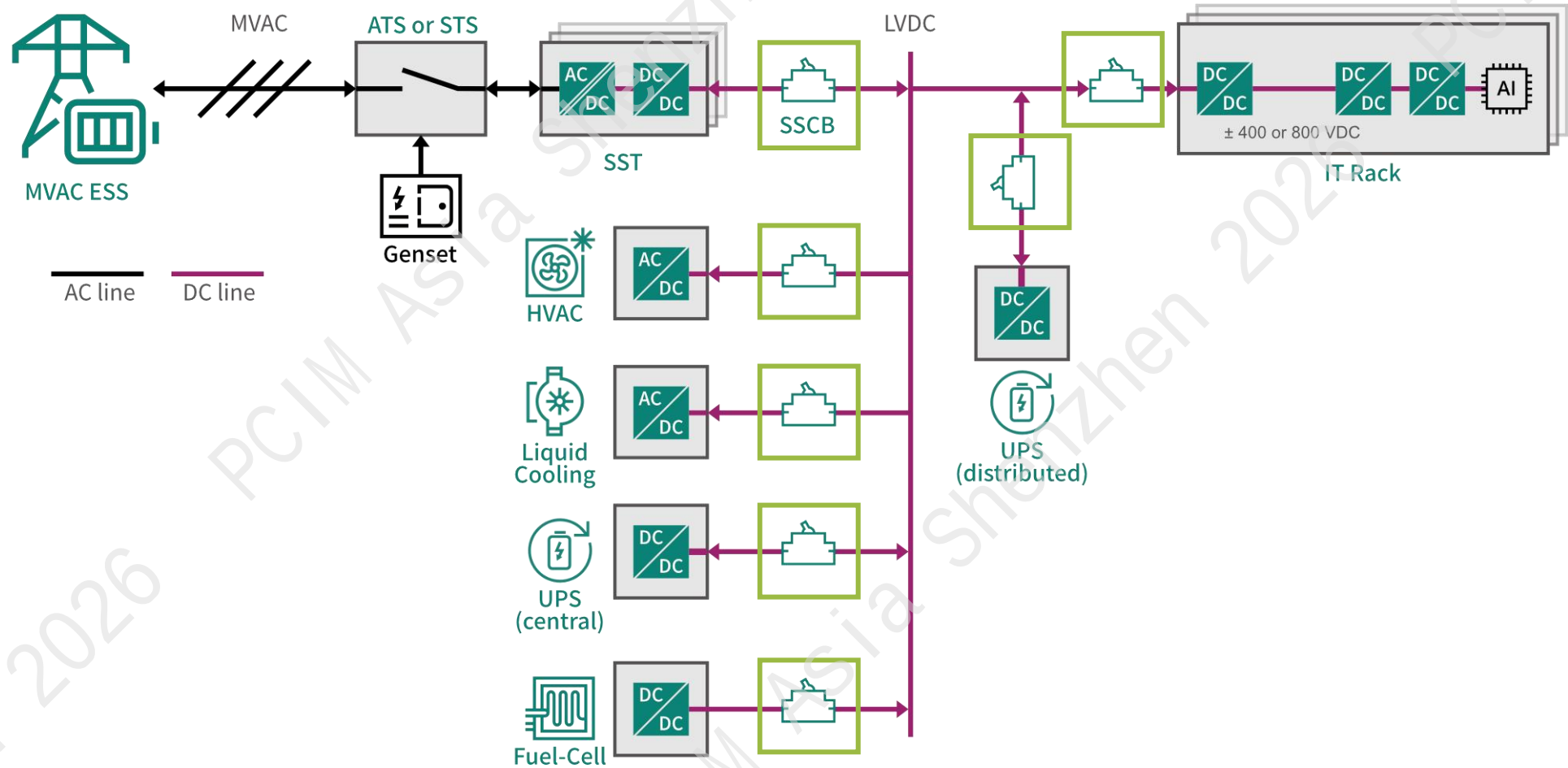
SSCBs, DC Breakers



Battery Disconnect Unit (BDU), eFuse

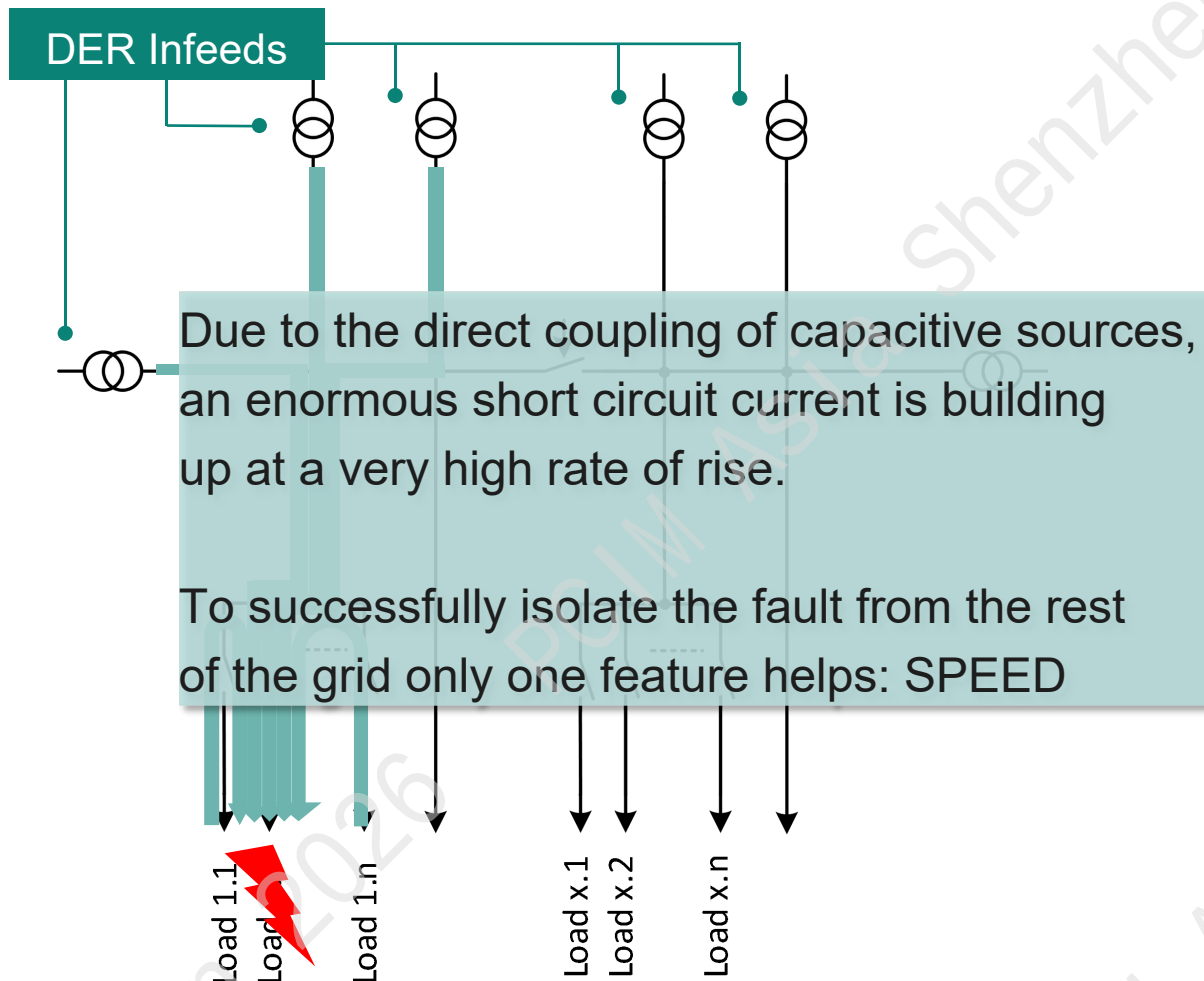
Solid-state circuit breakers 固态断路器 -- 直流微电网中每个节点的保护元件

A protection element for every node in a DC microgrid

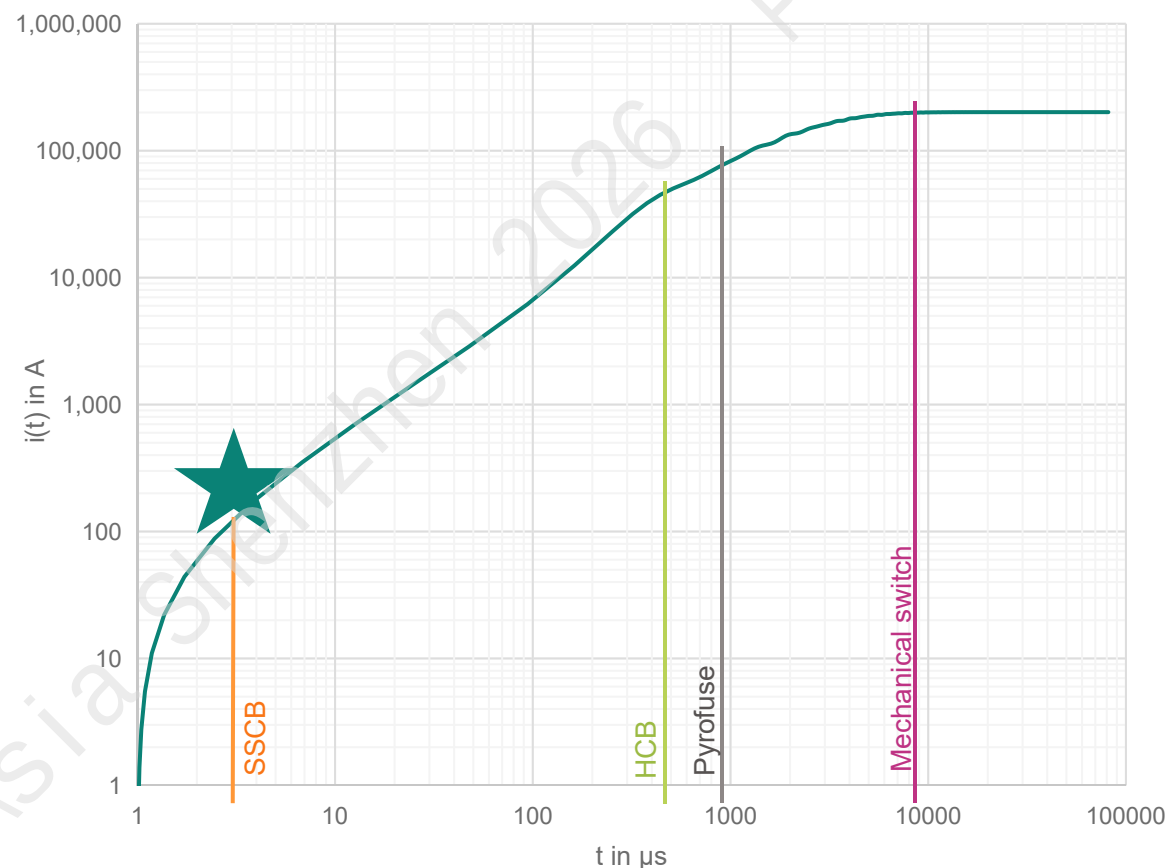


Handling short circuits in a DC grid is not an easy task

The only countermeasure: speed 快速关断是处理直流电网中短路的唯一应对措施



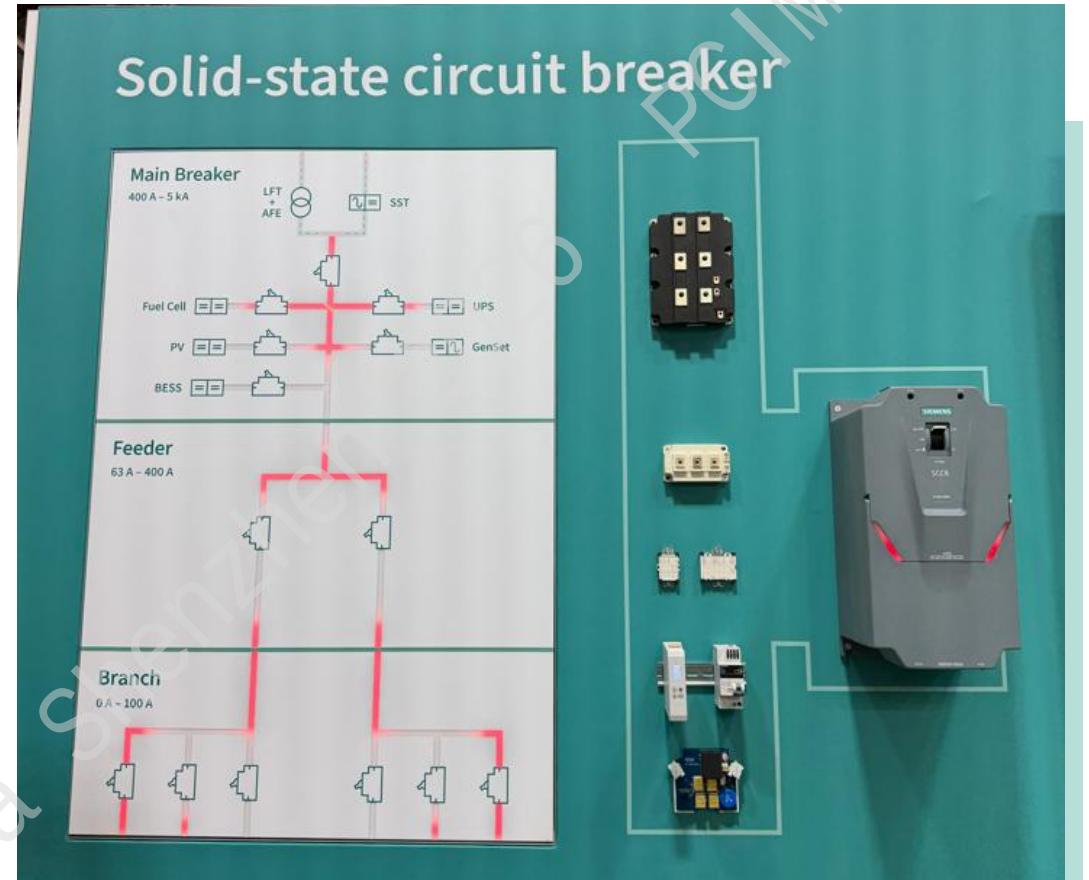
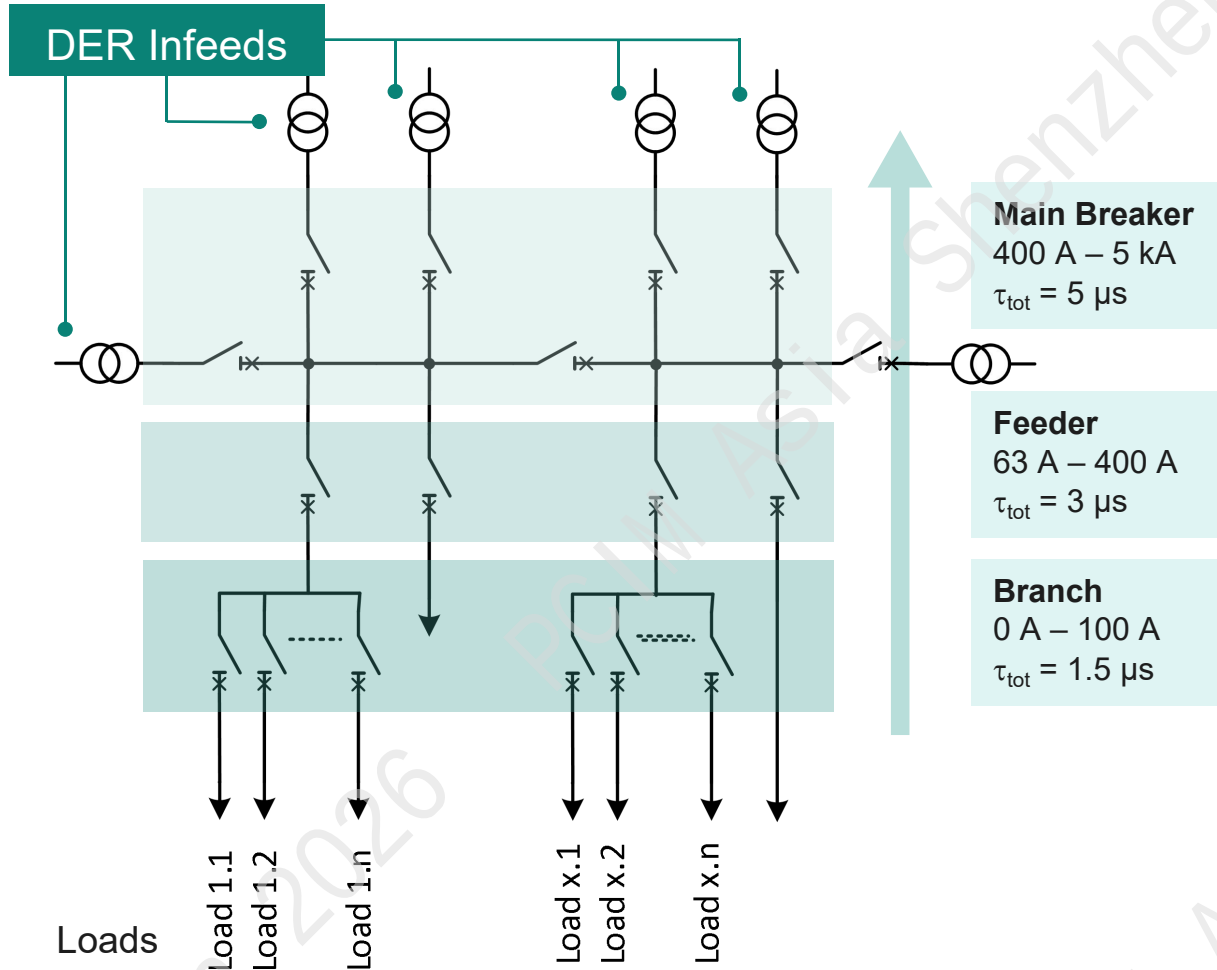
Fault current of 800 V_{DC} power distribution scheme



Required trip time < 300 μs , ideally << 10 μs

SSCBs within a full-scale distribution scheme 全配电架构中的固态断路器

A complete distribution scheme comprises three frame/ampacity sizes



τ_{tot} ... fault isolation delay ($I_{\text{pole}} \geq I_{\text{OCD}} \rightarrow V_{\text{DS}} > V_{\text{bus}}$)

Introducing JFET based solid-state circuit breaker demonstrator

基于JFET的固态断路器参考设计

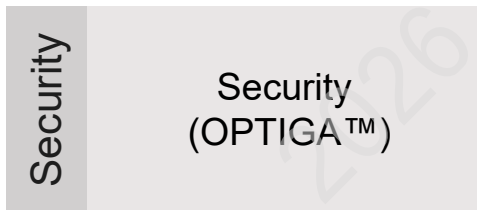
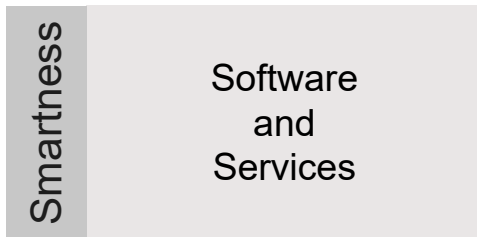


Solid-State Circuit Breakers from a System Perspective -- Wide range of product offerings for supply, control and actuation 固态断路器系统解决方案，涵盖电源、控制和驱动产品

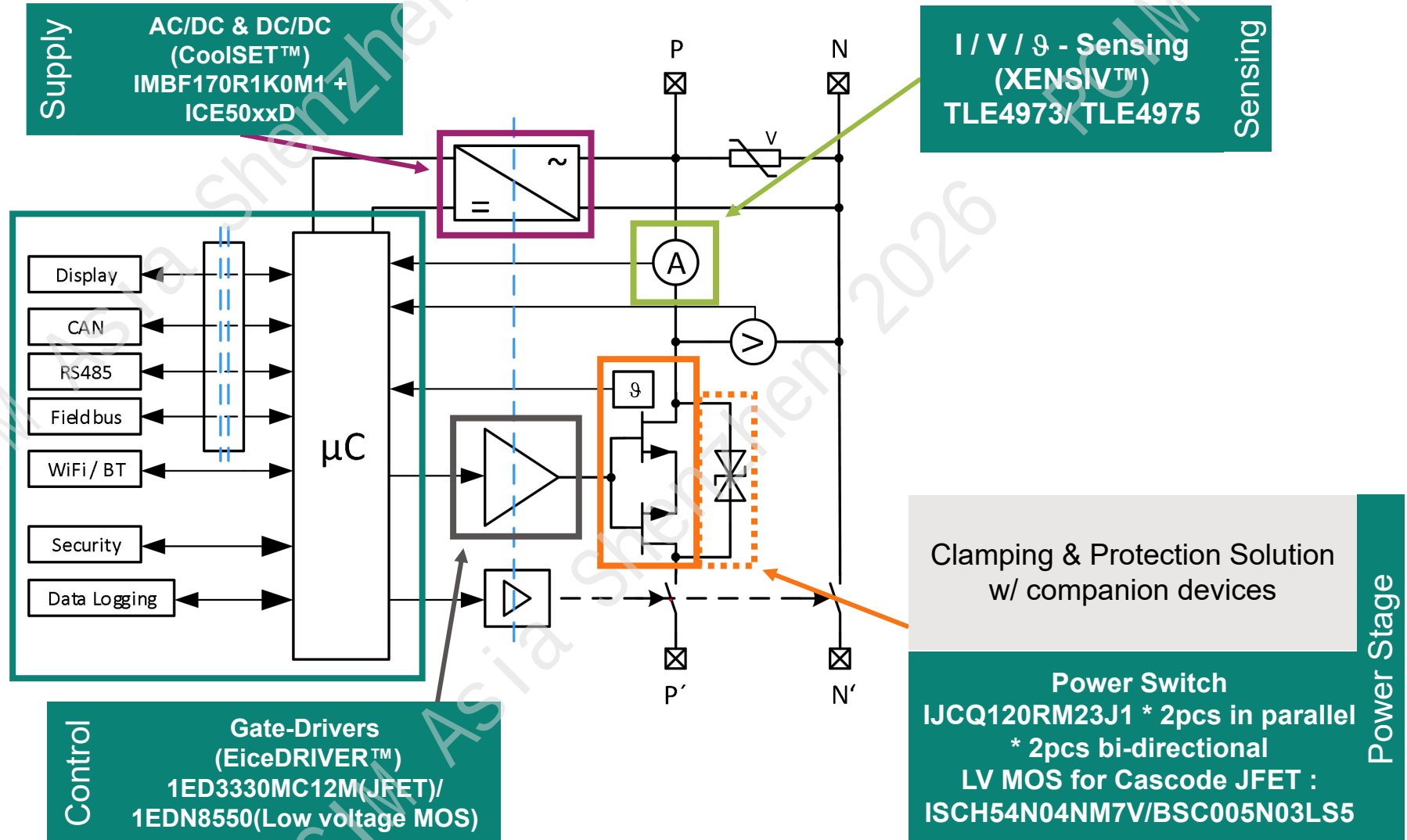
800VDC as reference



MCU feature: Sampling,
Protection Communication

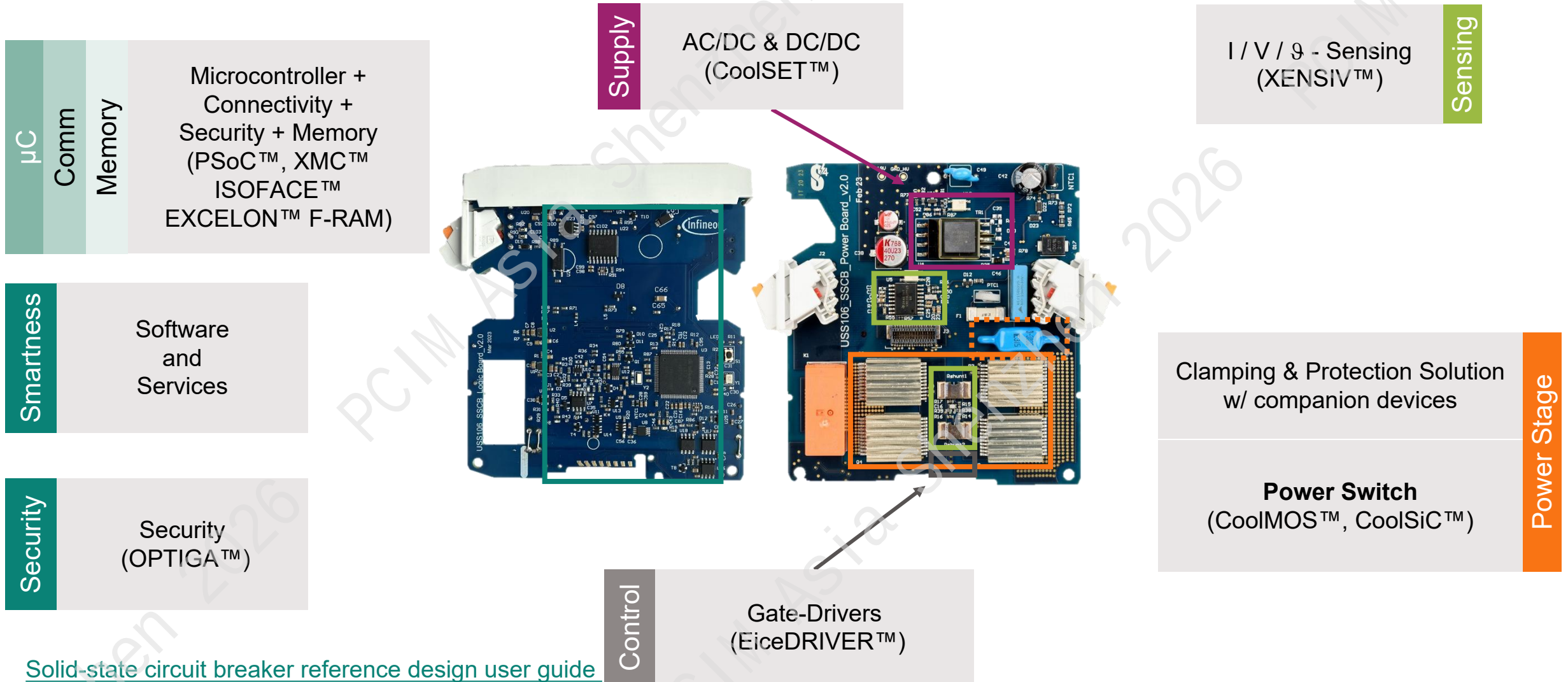


PGO
Recommendation



Solid-State Circuit Breakers from a System Perspective -- Wide range of product offerings for supply, control and actuation 固态断路器系统解决方案，涵盖电源、控制和驱动产品

REF_SSCB_AC_DC_1PH_16A / REF_SSCB_AC_DC_1PH_SiC



[Solid-state circuit breaker reference design user guide](#)

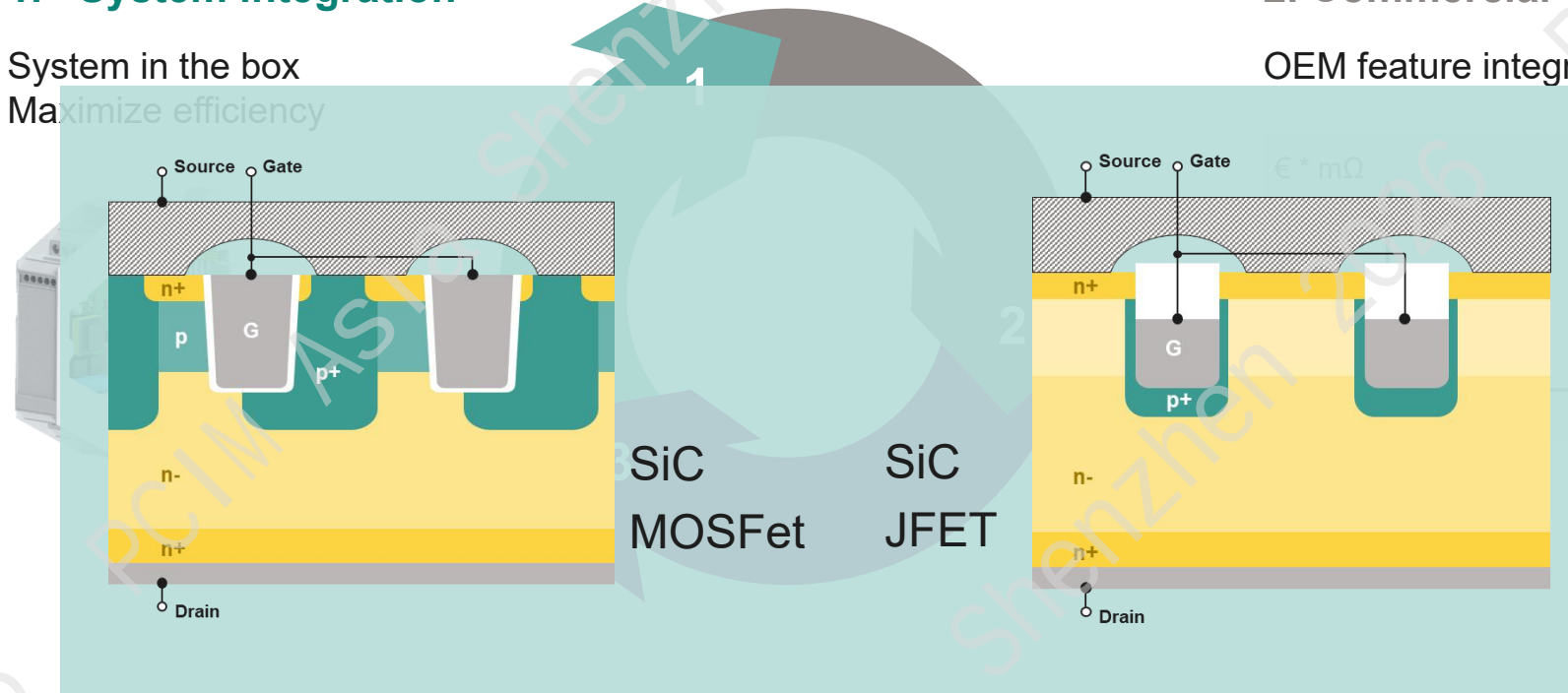
Technologies for solid-state power distribution 固态配电解决方案

Key technology selection criteria



1. System integration

System in the box
Maximize efficiency



2. Commercial viability

OEM feature integration

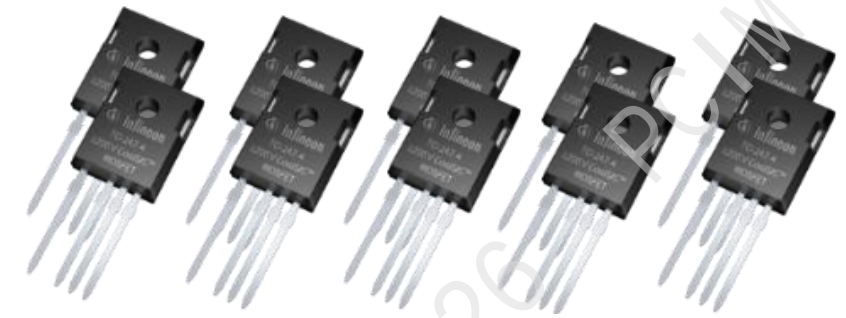
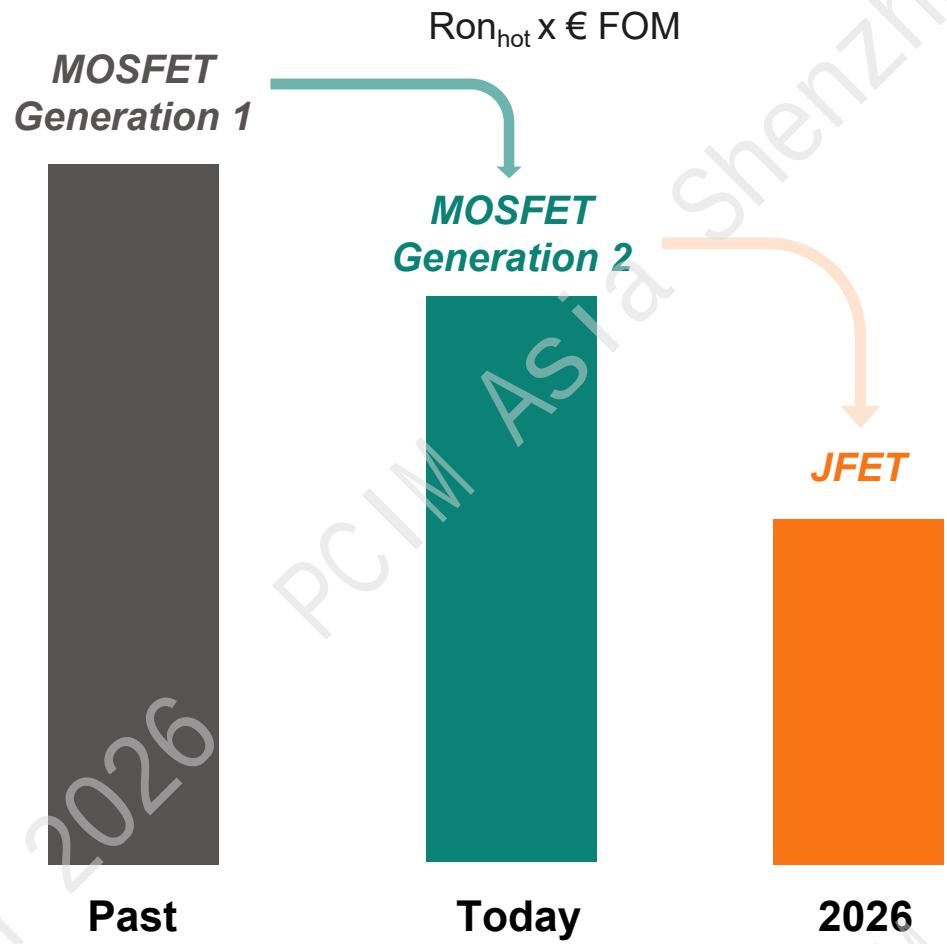
3. Robustness and reliability

15 years * 24/7 full load operation
Overload, overcurrent and UIS robustness

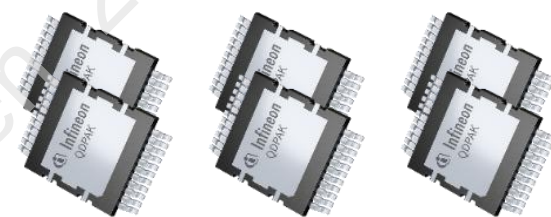
Most rugged and simple technology is preferred



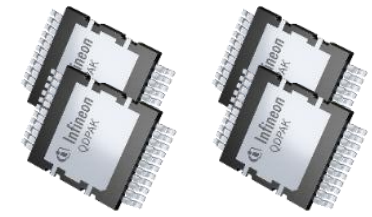
CoolSiC™ JFET: Price-Performance driven miniaturization



CoolSiC™ MOSFET Generation 1



CoolSiC™ MOSFET Generation 2



CoolSiC™ JFET

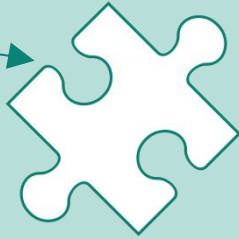
$R_{on,hot} \times \epsilon$ FOM Scaling of 1200V / 750V SiC FET Technologies at $T_j = 105^\circ\text{C}$ Estimated number of power semiconductor required per pole for 32A SSCB

CoolSiC™ JFET: Built for power distribution

CoolSiC™ JFET : 专为电力分配而设计

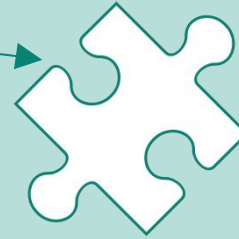
“Conduct”

$R_{DS(on)}$ puzzle piece



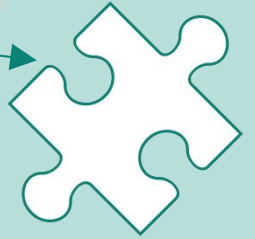
“Connect”

Linear mode piece



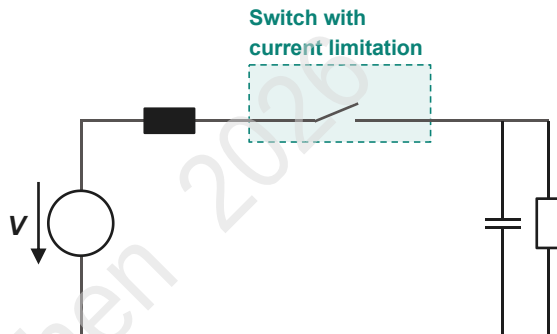
“Disconnect”

Avalanche piece



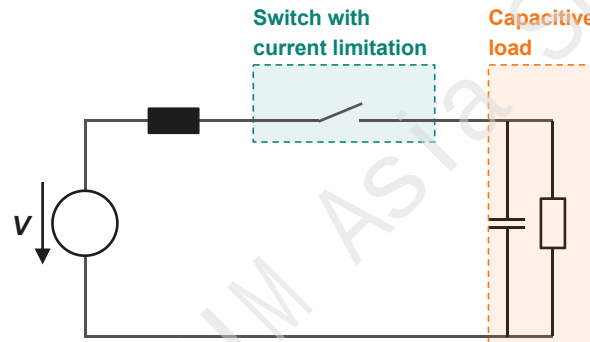
Low $R_{DS(on)}$ per area

- The JFETs open and close a circuit.
- No switched-mode power supply



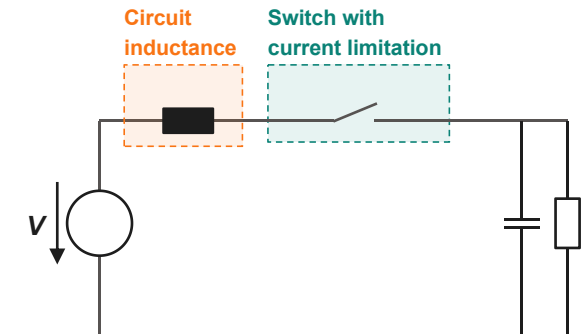
Linear mode stability

- Example: inrush currents when powering a capacitive load with a voltage source
- Linear mode makes a JFET high-ohmic
- The resistance of a JFETs limits inrush



Avalanche ruggedness

- Example: overvoltage when opening a circuit with an inductance
- The inductance will force an overvoltage
- The switch needs to cope with it.



Infiniteon's new CoolSiC™ JFET 750 V / 1200 V discrete portfolio

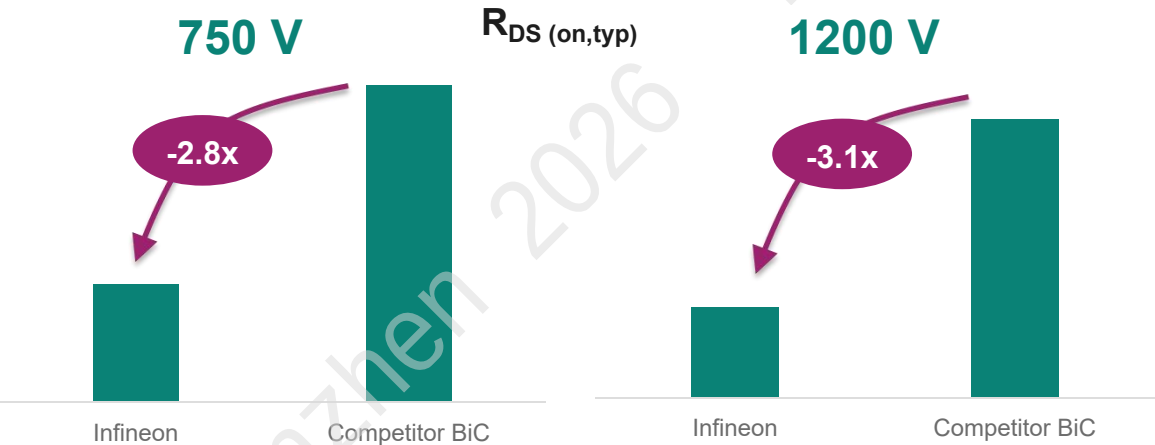
英飞凌全新 CoolSiC™ JFET 750 V / 1200 V 分立器件产品组合



Solid State
Power Distribution

CoolSiC™	$R_{DS(on,typ)}$ [mΩ]	Q-PAK
750 V	1.6	IJCQ75RM16J1 BiC
	2.2	IJCQ75RM22J1
	4.1	IJCQ75RM41J1
1200 V	2.3	IJCQ120RM23J1 BiC
	2.6	IJCQ120RM26J1
	5.0	IJCQ120RM50J1
	6.1	IJCQ120RM61J1

New CoolSiC™ JFET technology achieving **industry-leading lowest $R_{DS(on)}$ per device**



SSCB



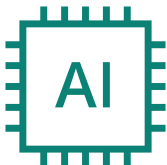
Battery
disconnect



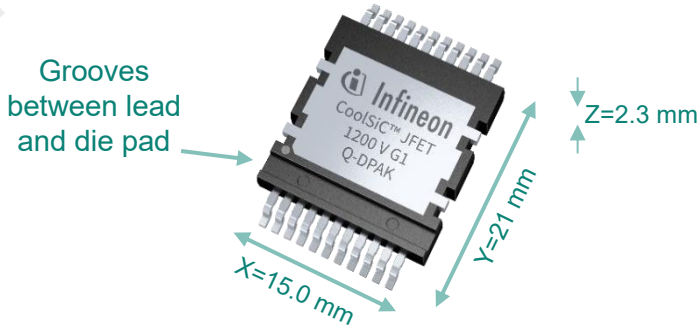
Solid-state
Motor Starter



eFuses and SSR



Hot Swap



BiC: Best-in-class

Disclaimer: $R_{DS(on)}$ values and part numbers are subject to finalization

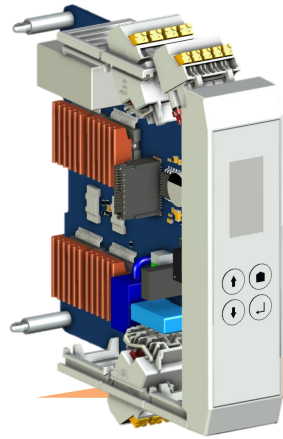
System understanding is the solid basis for our solution path 固态参考设计

SSCB Proof-of-Concept (PoC), Technology driven miniaturization and CAPEX savings

REF_SSCB_AC_DC_1PH_16A / REF_SSCB_AC_DC_1PH_SiC/ JFET version incoming

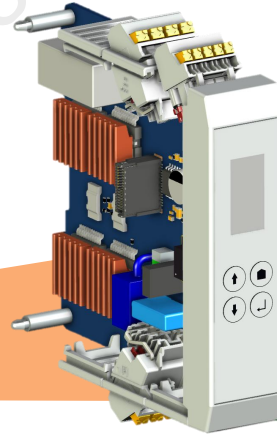


CoolIMOS™



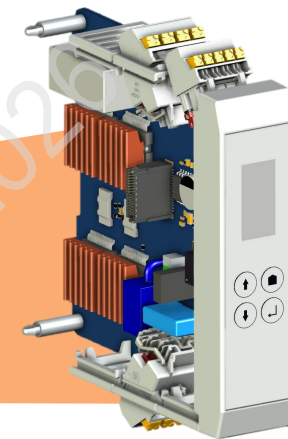
16 A

CoolSiC™ MOSFET



32 A

CoolSiC™ JFET



63 A*

Incoming

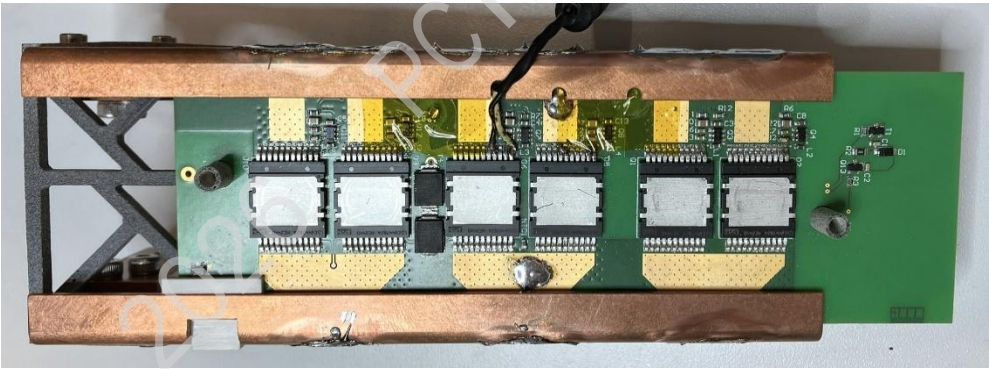
Highest ampacity
Smallest form factor

Pushing application limits, reducing total cost of ownership (TCO)

*SSCB current rating based on 750V QDPAK @1.5mOhm $R_{DS(on)}$

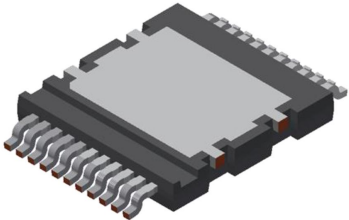
S²BD functional prototype

CoolSiC™ JFET Q-DPAK REF-SSBD800VDCJCQJ1



Voltage	< 850 V DC	Unipolar blocking
Current	800 A(*) DC	Water cooling
Additional Features	• Voltage and current measurement • Software defined trip characteristic • Fast short circuit shut down • Pre charger (optional)	
Product	6 x IJCQ120RM23J1	
R _{DS(on)}	730 μΩ @ 25C	Total resistance
Technology	JFET	1200 V
Temperature	-40 °C ... 85 °C	Ambient
Dimensions	204 x 62 x 41 mm	l x w x h
Connection	25 x 5 mm ²	Busbar – screw connection

(*) simulated, to be confirmed

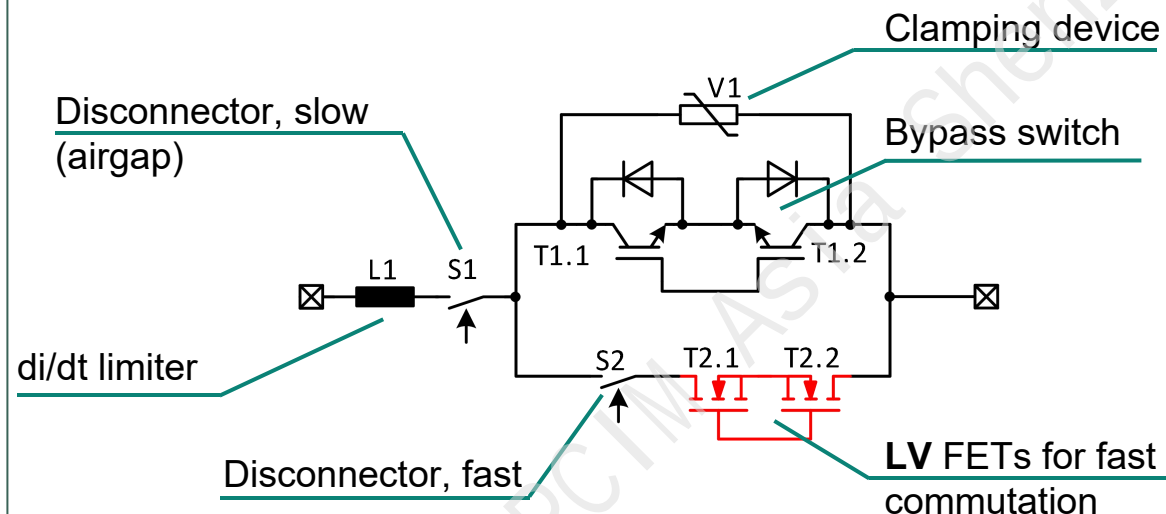


Hybrid vs. Solid-State Circuit Breakers

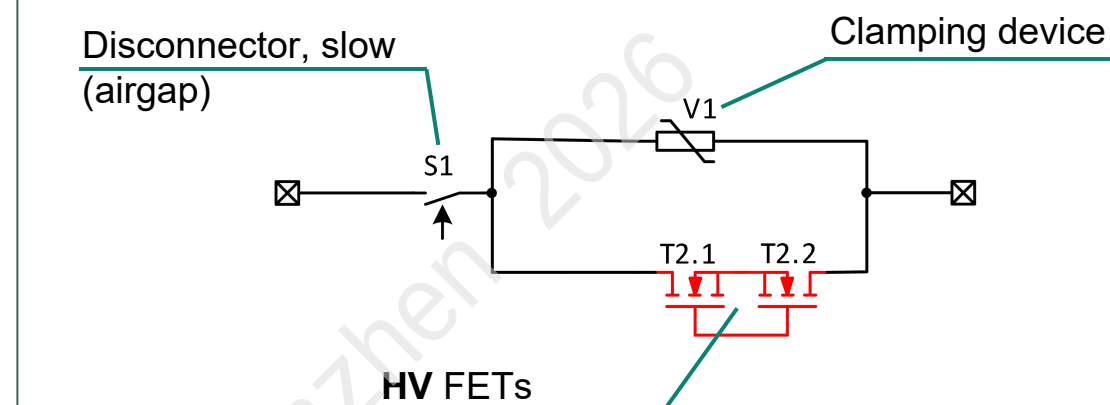
Hybrid implementations as bridge technology to full solid-state solutions

混合与固态断路器拓扑 - 混合固态是通往全固态解决方案的桥梁技术

Hybrid Circuit Breaker

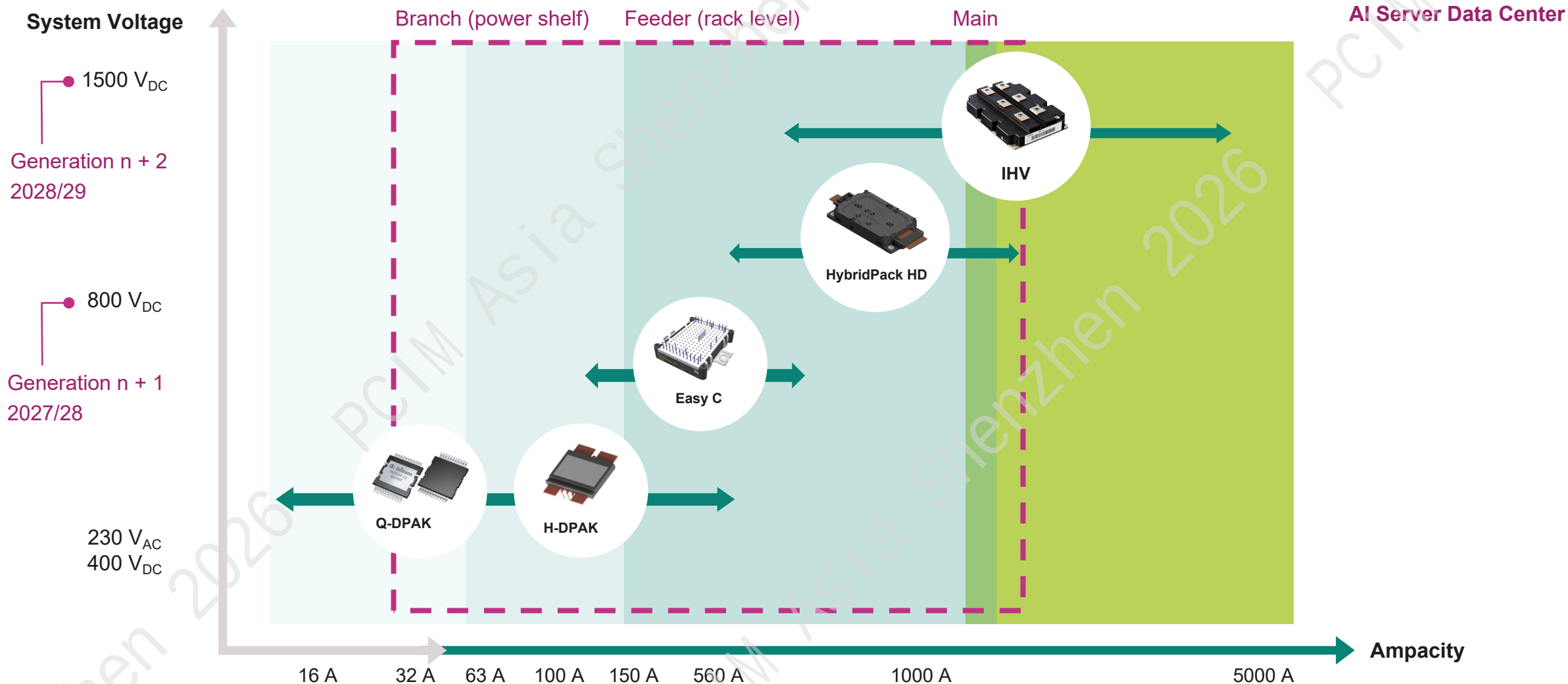


Solid State Circuit Breaker

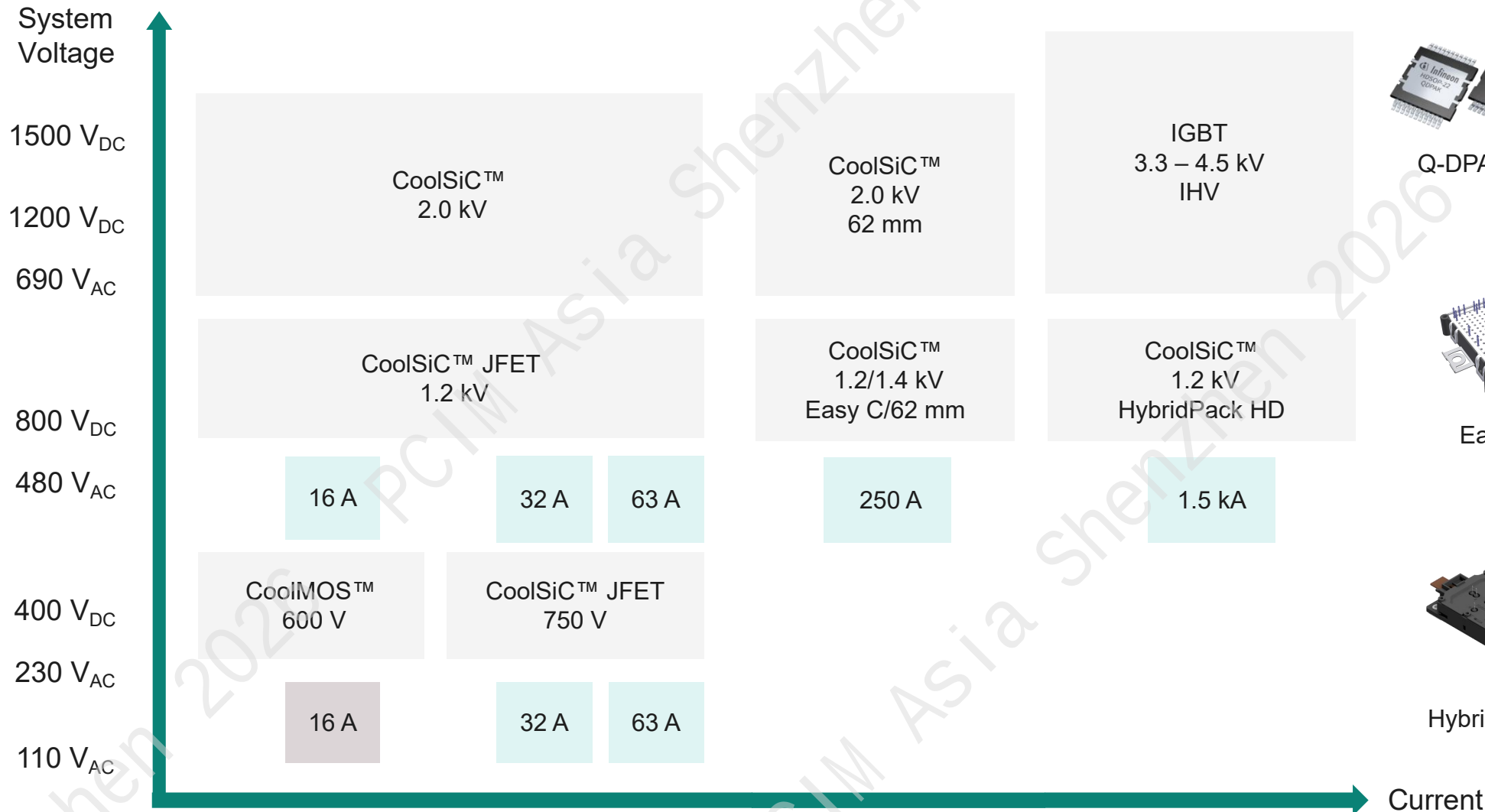


- Solid State implementations provide superior switching performance, however they cannot provide galvanic separation
- Most standards (**IEC60947-10, UL489I**) require a mechanical disconnecter that provides
 - The necessary airgap
 - Zero leakage current
 - Redundancy and diversity for the disconnection element
- The presence of a disconnecter supports the optimization of the semiconductor switch

Solid-state power distribution focus areas 固态配电重点关注领域

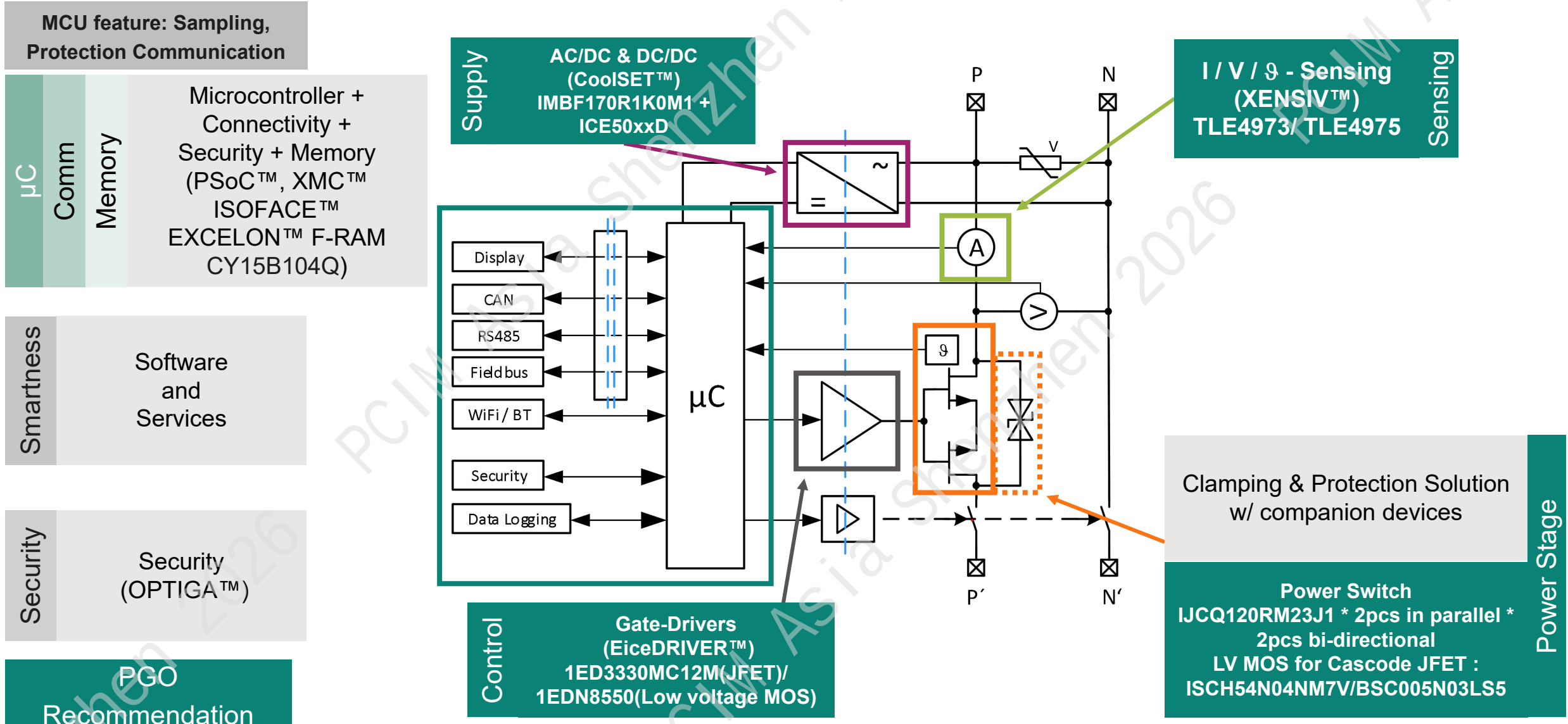


Complementary discrete and power module portfolio



Solid-State Circuit Breakers from a System Perspective -- Wide range of product offerings for supply, control and actuation 固态断路器系统解决方案，涵盖电源、控制和驱动产品

800VDC as reference



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REF_SSCB_AC_DC_1PH_16A / REF_SSCB_AC_DC_1PH_SiC

